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A MANUAL OF SURGICAL TREATMENT

A Manual of Surgical Treatment

BY

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LONGMANS, GREEN AND CO.

LONDON AND BOMBAY

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In Six Parts



PART VI.

SECTION I.

The Treatment of the Surgical Affections of the Tongue and Floor of the Mouth, the Pharynx, Neck, Œsophagus, Stomach and Intestines.

LONGMANS, GREEN AND CO.
39 PATERNOSTER ROW, LONDON
AND BOMBAY
1902

To

THE RIGHT HON.

LORD LISTER, LL.D., P.R.S.,

THE FOUNDER OF MODERN SURGERY,

WITHOUT WHOSE WORK MUCH OF

THIS BOOK COULD NOT HAVE

BEEN WRITTEN.

AUTHORS' PREFACE.

GENERAL PREFACE.

The subject of Surgery has now become so extensive that any work attempting to deal with it in an exhaustive manner must necessarily be so large and unwieldy as to be suitable only for purposes of reference, or for the use of those who devote themselves exclusively to its practice. In any text-book of convenient size the information given in certain branches of the subject must therefore be considerably condensed, and, as the first essential for the beginner is to have the fullest knowledge of the nature and characters of the diseases that he has to study, special stress is usually laid upon pathology, symptomatology, and diagnosis. For the practitioner, on the other hand, who is already acquainted with these points, the great essential is full and detailed information as to the best methods of treatment.

We have ourselves frequently experienced the want of detailed information, especially as regards the after-treatment of our cases, and have had to learn the best methods of procedure from experience. Nothing can of course replace experience, but it is often of the greatest advantage to have a detailed record of that of others upon which to base one's work. It is this want that the present work is intended to supply. We have tried to put ourselves in the place of those who have to treat a given case for the first time, and we have endeavoured to supply them with details as to treatment from the commencement to the termination of the illness. We have assumed that the reader is familiar with the nature and diagnosis of the disease, and we only refer to the pathology and symptoms in so far as it is necessary to render intelligible the principles on which the treatment is based, and the various stages of the disease to which each particular method is applicable.

We have purposely avoided attempting to give anything like a complete summary of the various methods of treatment that have from time to time been proposed: to do so would merely confuse the reader. Only those plans are described which our experience has led us to believe are the best, but with regard to these we have endeavoured to state exactly and in detail what we ourselves should do under given circumstances. In some cases no doubt several methods of treatment are of equal value, and while we have only discussed at length that which we have ourselves been led to adopt, we have referred shortly to the others.

We have not mentioned all the exceptional conditions that may be met with, but we have endeavoured to include all the circumstances with which the surgeon is most commonly called upon to deal. The task has been one of some difficulty, the more so as we have had, to a certain extent, to break new ground. This must serve as our excuse for the many shortcomings in the work.

PREFACE TO PART VI.—SECTION I.

We regret that we have been unable to complete the Manual in six volumes as originally intended, but we have thought it best to divide the last Part into two volumes for the following reasons. To have attempted to include the whole of the remaining subjects in one volume would have entailed the condensation of the matter and we should thus have abandoned the leading motive of the work, namely the full discussion of the treatment of the various diseases, and moreover it would have entailed still further delay in issuing the volume. It seemed therefore more likely to meet the views of those who have subscribed for the book to adhere to the full discussion of the treatment and to divide the last Part into two volumes of fairly manageable size.

We regret also that this volume has been somewhat longer in making its appearance than its predecessors. This is partly due to its size and to the larger amount of material requiring to be worked up, and partly to the fact that, owing to the absence of one of us in South Africa, the printers have been able to overtake us. We hope that the remaining volume will be ready for issue within a few months.

We are considerably indebted to Dr. Otto F. F. Grünbaum, Clinical Pathologist to King's College Hospital, for his kindness in contributing three highly practical notes upon subjects to which he has devoted much attention, viz., Rectal feeding, Test-meals, and Leucocytosis. To Messrs. Longmans we are indebted for Figs. 14 and 15 from Gray's *Anatomy*, and Messrs. Down Bros. have again placed at our disposal their large collection of illustrations of surgical instruments.

With the above exceptions all the illustrations in this volume have been drawn by Mr. T. P. Collings, either from sketches or actual preparations, and to him we return our best thanks for the care and skill he has bestowed upon a difficult task.

London. *March*, 1902.

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DIVISION I.

THE SURGICAL AFFECTIONS OF THE TONGUE AND FLOOR OF THE MOUTH.

CHAPTER I.

CONGENITAL MALFORMATIONS, INJURIES, AND INFLAMMATORY AFFECTIONS OF THE TONGUE.

CONGENITAL AFFECTIONS OF THE TONGUE.

As the chief congenital deformities are not amenable to surgical treatment little need be said about them. Several, such as deficiency, undue length, or a bifid condition of the organ, are very rare, as is also the true congenital form of macroglossia. One form of this affection may no doubt be present at birth, but it is due essentially to lymphangioma, and is not therefore a true congenital deformity; it is considered later (see Chap. III.).

"**TONGUE TIE.**"—In the affection known as anchyloglossia, or "tongue tie," the frenum linguæ is abnormally short, and the tongue cannot be protruded properly. This condition, however, generally passes off as the child gets older, and very seldom calls for treatment.

Treatment.—The division of the frenum, so frequently practised on infants, is strongly to be condemned for several reasons. On the one hand, it is unnecessary in the majority of cases, for the frenum gradually lengthens as the child gets old, while, on the other hand, the operation may be followed by a scar which permanently ties down the tip of the tongue and exaggerates the original trouble.

When the frenum is extremely short, and it is absolutely necessary to divide it, a transverse slit should be made close to the symphysis, so as to leave the portion of the frenum beneath the tip of the tongue uninjured, and it is well, after firmly pulling up the tip of the organ and thus converting the original transverse incision into a lozenge-shaped space, to put one or

two fine catgut stitches between the lateral angles of the lozenge so as to prevent the occurrence of a granulating surface which might subsequently lead to contraction. This small operation can be done under eucaine, the area of the operation being swabbed with a 10% solution on a pledget of wool. The tip of the tongue should be pulled out with tongue forceps, and the mouth should be propped open with a gag. On the whole, perhaps it is better, however, to employ general anæsthesia, as the operation has to be done in young children, who are usually troublesome, and in whom also the employment of eucaine may possibly be accompanied by danger.

TRAUMATIC AFFECTIONS OF THE TONGUE.

WOUNDS.—The most common wound of the tongue is a *laceration* from a bite, and this frequently occurs in epileptics in whom the tongue is protruded between the teeth and bitten as the jaws come together during the convulsion; the tongue is sometimes severely lacerated. Another common example of this accident is when a child runs with the tongue protruded and falls upon the chin, snapping the jaws together and biting the tongue. True *incised wounds* of the tongue are very rare.

Treatment.—In epileptics the treatment must be *prophylactic*; whenever a fit is imminent, a cork, a roll of bandage, or a piece of wood should be inserted between the teeth, and held there during the fit so as to prevent the tongue being bitten.

These injuries usually heal readily without any septic troubles, although in some cases comparatively severe septic inflammation may follow them. As a rule the *hæmorrhage* is not severe enough to call for any but the mildest measures for its arrest. The patient should be placed in a good light, the mouth widely opened, the tongue pulled forward, the cut surface dabbed over with a pledget of wool soaked in a 20% solution of eucaine, and carefully examined. Any spouting vessel should be seized in artery forceps and tied with catgut, while, if the surface simply oozes freely, sucking a piece of ice wrapped up in muslin will check it readily. When the wound is large, it is a good plan to put in one or two catgut *stitches* deeply through its edges so as to press the lateral surfaces together; this both arrests the bleeding and closes the wound. As a rule, when this has been done, the wound heals without much trouble, even though a large portion of the tip of the tongue may have been freely detached. All the necessary manipulations are quite easily done under eucaine.

An antiseptic mouth-wash, such as equal parts of a saturated boracic solution and hot water, a tablespoonful to the pint of sanitas, or a very weak solution of permanganate of potash, should be used at frequent intervals. For 48 hours the patient should be kept on a liquid diet, which should be directed along the sound side of the mouth, the head being held over to that side in order to facilitate the passage of the food;

immediately afterwards the mouth should be thoroughly rinsed out with the mouth-wash prescribed.

BURNS AND SCALDS.—These are not uncommon in children, who, playing with the spout of a kettle, inhale the steam or swallow the boiling water. It may also result from the accidental or intentional swallowing of caustic fluids, such as a mineral acid or a caustic alkali. As a rule, the effect of the irritant upon the tongue is quite overshadowed by the symptoms produced by the burn or scald of the pharnyx which almost invariably accompanies it. The tongue, however, swells up and becomes very painful, being profusely blistered or actually ulcerated, and, if there be much swelling towards its base, respiration may be seriously interfered with.

Treatment.—The best thing is to *prick any blisters* at once and make the patient suck ice; should excessive swelling occur, *superficial incisions* should be made in the tongue to allow of the escape of the œdematous fluid. These incisions should run parallel to the raphe, and should be made from behind forwards over the swollen portions of the tongue. They need only go through the mucous membrane; eucaine gives a sufficient anæsthesia.

INFLAMMATORY AFFECTIONS OF THE TONGUE.

Two forms of inflammation of the tongue may be met with,—the parenchymatous and the superficial glossitis,—and either may be acute or chronic.

ACUTE PARENCHYMATOUS GLOSSITIS.—This is a comparatively rare affection, but it may follow various infectious fevers, such as erysipelas or scarlet fever; in a minor degree it may result from mercurial poisoning, it may occur as a sequel to some ulcer of the tongue or floor of the mouth, or it may be caused by a bite or sting of a venomous insect. Sometimes the affection implicates the whole of the tongue, sometimes, but more rarely, one half alone (hemi-glossitis) or the base alone may be affected.

If seen early and carefully treated, the condition generally ends in resolution, but sometimes suppuration takes place and an abscess forms, usually between the genio-hyo-glossi muscles. When the inflammation is acute, and especially when it affects the base of the organ, there may be dangerous embarrassment to respiration.

This form of glossitis may also be the starting point of the condition known as Ludwig's angina, which is described in connection with ulceration of the floor of the mouth (see Chap. V.).

Treatment.—The first essential is to diminish the swelling of the tongue; should suppuration occur, the abscess must be opened. In the first instance a *purge* (calomel grs. v. or mist. alb. ℥ jss.) should be administered, and, unless the condition be very urgent, *an antiseptic mouth-wash*

(boric acid, sanitas, Condy's fluid, etc.), as hot as the patient can conveniently bear it, should be used about every half hour. If the case be acute, but still without embarrassment to respiration, four or five *leeches* (see Part I., p. 5) may with advantage be applied externally to the hyoid region. Should these measures fail to relieve the swelling, or should the latter be so marked as to give rise to dyspnœa, the best plan is to make *free incisions* into the tongue under a general anæsthetic, such as gas or gas and oxygen. The incisions should be made on the dorsum on one or both sides of the organ according as half or the whole of it is affected, and should run parallel to the long axis of the tongue throughout its whole length, and should extend well down into the muscular tissue. Bleeding should be encouraged by the employment of *hot boracic mouth-washes* after the effect of the anæsthetic has passed off. The object of the incisions is to permit of the free escape of the œdematous fluid, and so to diminish the size of the tongue.

Abscess of the tongue.—The situation of the abscess varies very much; perhaps it is most common among the muscles below the tongue, so that, by pulling up the organ with forceps, incising the mucous membrane in the middle line or a little to one side—taking care to keep well internal to the ranine arteries—and then pushing sinus forceps into the substance of the tongue in the direction of the abscess, the pus can usually be evacuated. A free opening should then be made and drainage provided for by introducing a strip of gauze into the cavity; this should be changed twice daily until the cavity has closed sufficiently to make drainage unnecessary. This will usually be the case in three or four days, and it will be then only necessary to continue with the antiseptic mouth-washes (see p. 2).

When the abscess is large and extends downwards for some distance, the best plan is to make a counter-opening beneath the symphysis and to introduce a drainage tube; unless this be done, the abscess will not drain properly, the inflammation may continue, and a troublesome sinus may form below the chin. On the whole it will probably be more satisfactory to open a very large abscess of this kind from the outside.

Antiseptic mouth-washes (see p. 2) should be employed afterwards, and the condition will subside quickly unless there be a streptococcal inflammation and the condition known as Ludwig's angina (see p. 64) sets in.

ACUTE SUPERFICIAL GLOSSITIS.—This affection is not very common.

1. The most common form is that met with in connection with a growth of the oidium albicans in children,—the condition known as "*thrush.*" In this condition, which may or may not be serious, little whitish patches like curd of milk appear on the tongue and mucous membrane of the mouth, tonsils or pharynx, increase in size rapidly, and coalesce to form fairly large patches; the affection may spread to some extent on to the pharynx. The child is generally ill, and there is usually bad diarrhœa. The affection

also occurs in adults, and especially those who are prostrated by severe disease such as phthisis. The condition is due to the growth of the oidium albicans in the superficial layers of the epithelium, and is predisposed to by imperfect nutrition such as results from starvation, debilitating illnesses, etc.

2. Acute superficial glossitis often accompanies ulceration of the mucous membrane of the mouth—the so-called *ulcerative stomatitis.*

3. In some cases an eruption of *herpes* occurs on one half of the tongue leading to a superficial inflammation accompanied by the formation of vesicles and minute ulcers.

4. Lastly, acute superficial glossitis may also occur in connection with *foot and mouth disease.*

Treatment.—1. *Of "thrush."*—In the first place the strictest cleanliness must be observed with regard to the feeding vessels; the proper sterilisation of the milk, from which the organism usually comes, is very important. The patches should be brushed well over with a camel's hair brush kept in a 1-20 carbolic acid solution, or with a piece of linen previously sterilised by boiling. The best application is glycerinum boracis painted on several times a day either pure or diluted with a little water. A dose of calomel (grs. i.-ii.) should be given occasionally to clear out irritating material from the bowels, and the patient should be placed under the best hygienic conditions possible. As a rule the affection subsides rapidly under this treatment.

2. *Of ulcerative stomatitis.*—Here the treatment of the inflammation of the tongue is merely a part of the general treatment necessary for the primary condition, the ulcerative stomatitis (see Part V., Chap. XVII.).

3. *Of herpetic inflammation.*—This condition is very mild and calls for little treatment beyond the use of antiseptic mouth-washes, such as chlorate potash (grs. xv. to the oz.), sanitas, etc. After the condition has lasted for a short time it is well to employ a more astringent form of mouth-wash, such as one containing alum (grs. ii.-v. to the oz.).

Sub-acute superficial glossitis.—The sub-acute forms of superficial glossitis met with are chiefly of clinical and pathological interest, as there is little to be done for them in the way of treatment. Chief among them is the condition variously described as "wandering rash," "ringworm of the tongue," etc., which consists of smooth, red, slightly elevated patches of a circular or oval shape. These run together, or the rings enlarge and lose their circular shape, or disappear in one place and appear in another. The condition is usually discovered accidentally, although in some cases it gives rise to troublesome itching. The disease occurs mainly in children, and its cause is quite unknown.

Treatment.—This chiefly consists in the employment of tonics internally, combined with various local anodyne and antiseptic applications. Although the condition may not yield to treatment, the patient may be assured that it is not likely to be followed by any serious result.

CHRONIC SUPERFICIAL GLOSSITIS.—The forms of chronic superficial glossitis are variously described under the names "leucoma," "ichthyosis," "smokers' patch," etc. The condition is not amenable to treatment to any marked degree, but its importance depends upon the prognosis; the more severe forms especially very often end in epithelioma, so that, even though the condition cannot be cured, it requires careful watching for the first appearance of cancerous disease.

Pathology.—The disease varies in severity in different cases, the least severe form being probably that which occurs in connection with smoking. It is a chronic inflammation of the tongue, the sub-mucous tissue being infiltrated with cells, and the papillæ in most cases disappearing and leaving a smooth, shiny patch which shows up well on drying the tongue. The epithelium becomes heaped up on the surface, and there the patch appears to be covered with a bluish layer which is whitish at the thicker parts, where it may also be indurated and fissured. The affection generally occurs between the ages of forty and fifty, and is more frequent in men than in women. Its causes are quite unknown, but it is usually attributed to long-continued irritation of the tongue. Smoking, alcohol and the irritation of carious teeth are potent factors in its production. It is possible also that syphilis predisposes to it.

Prognosis.—The great importance of the disease rests on the prognosis. Treatment has little effect upon it, and the tendency is for it to spread, and it not infrequently extends to the cheek. The patches, which at first are small and of a bluish tint, generally thicken, so that in some cases the condition described as "ichthyosis linguæ" may occur, and may be accompanied by widespread cracks and fissures. In other cases the patch, after remaining stationary for years, gradually develops on the surface a warty growth, which, although at first possibly non-malignant, is very likely to become the seat of epithelioma. In other cases again, one of the fissures in the patch gradually deepens, its edges harden and epithelioma develops. It is on account of this strong tendency to the development of epithelioma that the disease is so highly important, for usually the subjective symptoms are slight, and in the milder cases the condition is only discovered by accident.

Treatment.—1. **Prophylactic.**—Bearing in mind the tendency to the occurrence of epithelioma, and at the same time the improbability of curing the disease, care must be taken to avoid anything that can irritate and lead to the development of cancer. In the first place it is obvious that the known causes of irritation of the tongue should be avoided, such as smoking, and its frequently associated free use of alcohol. The consumption of very sweet or highly-spiced foods should be prohibited. As a rule it is well to interdict smoking, but in habitual smokers the occasional use of mild tobacco need not be absolutely forbidden; chewing tobacco must however be entirely stopped. The diet should be regulated, and any dyspeptic condition got rid of. All sources of irritation, such as

stumps, rough teeth, badly-fitting tooth-plates, etc., must be most rigorously investigated and remedied, because it is generally in connection with some injury from these causes that the epitheliomatous condition arises.

2. **Local.**—The greatest care must be exercised not to employ irritating applications. Caustics should be entirely avoided, and, as the disease is not likely to be cured, the local treatment should consist essentially in *soothing applications* calculated rather to enable one to keep a watch on the patient than to effect any marked improvement in the disease. Alkaline washes, such as bicarbonate of soda (grs. x.-xv. to the oz.), chlorate of potash (grs. v.-xv. to the oz.), and solutions of the glycerinum boracis are useful and give the most relief. The use of salicylic acid and strong solutions of chromic acid which are sometimes applied to the surface of the ulcer are dangerous as they cause irritation, and no attempt should be made to destroy the thickened epithelium. Butlin advocates the employment of ointments the basis of which is 2 parts of vaseline with 6 of lanoline; with this various drugs, such as borax, cocaine, morphine, etc., are combined. In applying it, the tongue is first dried, a small portion of the ointment is laid upon it and rubbed in by the patient pressing the tongue against the hard palate and moving it to and fro. This form of treatment seems to be specially indicated in those who sleep with the mouth open, and who generally suffer considerably from a hard, dry tongue in the morning. When the condition is associated with psoriasis elsewhere, the administration of arsenic may be beneficial, but in ordinary cases of leucoma the drug seems to be without effect.

A very important question is whether an attempt should be made to remove the leucomatous patch. Some have advocated that in bad cases of this character, especially those to which the term "ichthyosis" may be justly applied, in which carcinoma is certain to follow, it is well to *extirpate the leucomatous area*. This may seem a severe procedure, but, when there is a marked localised thickening of the tongue, especially when accompanied with induration or fissures, excision of the patch together with a portion of the deeper tissues is certainly advisable. Similarly, where there are warty excrescences, the area should be freely removed, but it is unnecessary to remove the whole or even half of the organ unless there be evidence of actual epithelioma.

Limited patches of this kind are excised by a more or less wedge-shaped incision, the base of the wedge being at the mucous surface so as to allow the gap to be closed with stitches. The bleeding is arrested, any spouting vessels are ligatured, and the raw surface is closed by catgut stitches, which, if inserted deeply and tied firmly, will stop the oozing by pressure.

Cases of leucoma should be seen regularly every three or four months, not so much with the view of doing anything as to keep a watch for signs of malignant disease. It does not do to prescribe for patients with leucoma and allow them to go away under the impression that everything has been

done that is required. At the same time of course one must be careful not to frighten the patient, as the dread of epithelioma may become a perpetual nightmare.

SIMPLE ULCERS OF THE TONGUE.

Ulcers occur on the tongue under various conditions, and may be spoken of generally as belonging to one of the following classes: Simple or non-specific, tuberculous, syphilitic and cancerous ulcers. In addition to these there are the rarer forms that occur in connection with leprosy or actinomycosis. We shall only consider here the simple ulcers; these are due to various causes, and their treatment will to a certain extent depend upon the cause.

TRAUMATIC ULCER.—A very common form of simple ulcer is due to an injury such as is produced by the irritation of rough teeth. It occurs especially about the tip or borders of the tongue, and the surface of the sore is generally irregular and sharply cut, with considerable redness of the tissues around; the ulcer is often associated with dyspepsia.

DYSPEPTIC ULCER.—Ulcers occurring in connection with dyspepsia are often spoken of as "dyspeptic ulcers," although their exact relation to the stomachic condition is not very clear. The ulcers are generally situated about the tip of the tongue or on the dorsum near the tip, but they may appear on the inner surface of the cheek, and they are always exquisitely tender. In addition to the ulcer there is often an irritable condition of the tongue in the neighbourhood, and the organ is generally thickly furred. In some dyspeptics there may be a superficial glossitis, not amounting to actual ulceration, which causes much discomfort, smarting and burning.

LEUCOMATOUS ULCER.—Ulceration is not uncommon in long-standing cases of chronic superficial glossitis. The ulcers occur about the centre of the leucomatous patches, and are often sensitive and difficult to get rid of. Sometimes the ulcer is very chronic, irregular in shape, like a deep fissure, and resembles a callous ulcer of the skin.

MERCURIAL ULCER.—Ulceration may also occur from the too free administration of mercury and is an exaggerated form of mercurial stomatitis.

DIPHTHERITIC ULCER.—Ulcerations of the tongue are also seen in diphtheria, in gangrenous stomatitis or in noma (see Part I., p. 80).

Treatment.—Of traumatic ulcer.—The first thing is to *ascertain the cause and to remove it.* This is especially advisable in the form of ulcer due to irritation from rough teeth, because these ulcers are extremely liable to develop into carcinoma in susceptible subjects. Any carious teeth should be filed and stopped or removed. In elderly subjects the teeth should be removed at once if there be any reason to doubt that milder measures will be successful. The mouth must be thoroughly cleansed, the remaining teeth scaled and cleane

if necessary, and an antiseptic mouth-wash of sanitas or weak glycerine and borax frequently employed. If the ulcer does not heal at once it may be painted once or twice daily with a 2% solution of chromic acid. At the same time attention must be paid to the state of the bowels and any dyspepsia appropriately treated. The exquisite pain that is met with in some of these cases may prevent the patient eating with any comfort, and this symptom may be successfully treated by the local application of a 10% solution of eucaine to the surface of the sore immediately before food; this will allay the pain and enable the food to be masticated in comfort. If the ulcer refuses to heal after this treatment it is well to examine a portion microscopically to make sure that the case is not one of commencing epithelioma.

Of dyspeptic ulcer.—When the ulcer is due solely to dyspepsia this must receive the treatment appropriate to the particular form present. In any case it is well to clear the bowels in the first instance and to see that they are kept open daily. The drugs most frequently useful are bicarbonate of soda, rhubarb and gentian, but of course these must be varied according to the essential nature of the disease, and the diet must be regulated accordingly; all irritating food must be avoided, and the food should be soft and non-irritating.

In the *local treatment* the cleansing of the mouth with frequent gargles of sanitas, chlorate of potash or boro-glyceride will be necessary. If the ulcers be painful, touching them occasionally with 2°/₀ solution of chromic acid will often relieve the pain. If healing be very slow, astringent lotions such as weak solutions of alum (grs. ii.-v. to the oz.) must be employed, and iron should be administered internally in the form of pil ferri (grs. v.-xv. t.d.s.) or syrup of the iodide of iron (ʒss-j).

Of leucomatous ulcer.—These ulcers are usually very difficult to treat, as they often remain unhealed for a long time, and, owing to the thickness of the tissues around, they may present all the appearances of a callous ulcer. In the first place all causes of irritation must be removed, and antiseptic and astringent washes, such as alum or tannin (grs. ii.-v. to the oz.), should be employed. In patients under middle age solutions of chromic acid (commencing with 2°/₀ and increasing up to 10°/₀) are useful and should be painted on the ulcer twice or thrice daily.

In very chronic cases the best treatment is to excise the ulcer when it is found that it will not heal under careful treatment. When the sore is the centre of a limited patch of leucoma, excision of the entire patch along with the ulcer is advisable, and should be done in the manner described for leucoma (see p. 7).

Of mercurial ulcer.—In mercurial stomatitis the inflammation tends to involve the tongue as well as the gums and cheek, and may lead both to inflammation of the tongue and to ulceration. The immediate removal of the patient from the influence of the drug is obviously called for here, whether it has been given internally for syphilis or whether the

affection occurs in a patient working in mercury. Besides this, a saline aperient should be given, and a mixture containing 10-15 grains of chlorate of potash should be administered three times a day. At the same time careful attention to the hygiene of the mouth is essential, the teeth being thoroughly brushed frequently with an antiseptic tooth powder containing chlorate of potash, carbolic acid and some astringent, such as areca nut, or catechu.

CHAPTER II.

SYPHILIS AND TUBERCULOSIS OF THE TONGUE.

SYPHILIS OF THE TONGUE.

Lingual syphilis is very common, and may be met with in all stages of the disease.

Primary chancre is, however, comparatively rare on the tongue, as it generally occurs on the lip or in the region of the tonsil when it affects the mouth. A chancre of the tongue is usually situated towards the tip or the anterior part of the dorsum.

Mucous patches.—These are extremely common in the course of secondary syphilis, and may be met with on any part of the tongue, being most frequent about its borders. They may occur also in the congenital form of the disease, and are usually multiple and accompanied by other manifestations of the disease elsewhere. The patches vary in appearance according to their situation on the tongue; when on the side they form elongated or oval areas, and are often fissured or ulcerated in the centre and very painful; on the dorsum the ulceration is not so marked, and the patch is generally smooth with whitish margins; while on the under surface they may present the warty appearance of the typical mucous patch.

In tertiary syphilis either **sclerosing glossitis** (localised areas of inflammation with thickening of the tissues beneath) or typical gummata may be met with. The first form causes deep fissures and ulcers on the tongue which are very typical. In the earlier stages they give rise to thickened patches of variable size, characterised by their white appearance, which somewhat resembles leucoma, and these areas are very liable to fissures or somewhat widespread ulceration.

The most frequent form of tertiary lesion is however a gumma, which may appear at any time during the tertiary stage. **Gummata** are seen either on the surface of the tongue or deep in the muscular tissue; the more deeply-seated forms are usually near the middle line. They may be single or multiple, and gradually break down and lead to a comparatively

deep ulcer. The ulcers to which they give rise present a fairly typical appearance, being usually deep and conical, with a foul sloughy surface, and without the raised everted edge so typical of epithelioma. At the same time there is often considerable induration about the ulcer, especially after some little time has elapsed, and it is not always easy to make a diagnosis between it and the cancerous form. It is worthy of note also that these ulcers are frequently followed by the development of epithelioma. The ulcers are nearly always preceded by gummata, and a careful enquiry into the history will generally elicit the fact that a lump existed before the ulceration occurred.

Treatment.—In the primary and secondary stages the patient must be treated on ordinary lines for syphilis generally (see Part I., Chap. XII.). In dealing with *mucous tubercles*, the local application of calomel is very valuable. The tongue should be held out of the mouth and carefully dried, and then a mixture of calomel with equal parts of boracic acid and starch should be blown or dusted upon the surface. This should be done twice or thrice daily, while at the same time the patient is brought under the influence of mercury in one of the ways already described (see Part I., Chap. XII.).

The *secondary ulcerations* are often very painful, and this symptom is best treated by the occasional application of solid nitrate of silver. In obstinate cases, painting the affected area over once or twice a day with a 10% solution of chromic acid is of great use. The patient should be limited to soft food, and must avoid smoking and anything acid or extremely hot or cold. In the very bad cases, marked by excessive pain which renders sleep and feeding matters of the greatest difficulty, the patient will go downhill in spite of the administration of mercury, unless it be given in such a way as to get him very rapidly under; intra-muscular injections (see Part I., p. 234) are especially valuable here. The local application of cocaine to the affected spot in order to enable the patient to take food in comfort (see p. 9) is sometimes very useful.

In treating the *tertiary ulcers*, the chief reliance must be placed upon the administration of iodide of potassium internally, and this should always be given in large doses, commencing with 15 grains three times a day and rapidly increasing the dose to 30 grains or even more. At the same time it is well to combine the drug with mercury (half a drachm to a drachm of the Liq. hydrarg. perchlor. with each dose). All irritating applications, such as caustics, should be carefully avoided, and local applications should be limited to mild antiseptic mouth-washes. Tobacco and alcohol in any form should be forbidden, and highly-spiced and acid articles of diet must not be taken. The most scrupulous attention should be paid to the condition of the mouth; rough teeth should be filed, stumps removed, all tartar taken away, and the teeth kept perfectly clean. This is very important, because epithelioma is very liable to follow if these sores be irritated. When the ulceration takes the form of a deep crack in the tongue, equal parts of

balsam of Peru and white of egg painted on several times a day with a camel's-hair brush is often beneficial, and an alkaline mouth-wash, such as carbonate of soda (grs. xv.-xx. to the oz.) is of great use. When the pain is very severe, the local application of orthoform may be useful; the surface of the sore should be dried before it is applied. In very bad cases it may be necessary to have recourse to morphine or cocaine to give temporary relief.

The most important cases are those in which the sore has lasted for some time and induration is developing about the sides of the ulcer. These cases are often extremely difficult to diagnose from epithelioma, which, moreover, as we have already said, is very likely to follow them. Too much stress cannot be laid on the importance of an early diagnosis, and this can only be satisfactorily made by the microscope, and therefore, in all cases where there is the slightest suspicion, a portion of the ulcer should be excised and submitted to microscopical examination, and, while this is being done, the patient must be put upon large doses of iodide of potassium. If the surgeon attempts to make up his mind from the results of the administration of iodide of potassium, two or three weeks at least are lost before the diagnosis is certain, even in the most favourable cases, and it is not uncommon to find that, even when the case turns out to be one of epithelioma, considerable improvement follows the administration of iodide of potassium within the first fortnight, so that the patient and the surgeon may be deceived into allowing still more valuable time to elapse.

TUBERCULOSIS OF THE TONGUE.

This condition is closely analogous to that already described on the lower lip (see Part V., p. 115). The ulcers may be primary, or may be secondary to tuberculous disease elsewhere; the primary form is extremely rare. In the vast majority of cases ulceration occurs in patients who are the subjects of phthisis or tuberculosis of the larynx or back of the throat, and the actual ulcer is usually the result of some injury such as irritation from the presence of a rough tooth, etc.

The ulcers are extremely painful, and give rise to very serious difficulty in swallowing. They are usually about the tip of the tongue, although sometimes they may appear on the dorsum further back. The ulcer varies from a crack at the tip of the tongue with hard edges, on separating which a deep fissure may be found, to a very superficial erosion beginning in a small vesicle and spreading from that. As the ulcer increases in size it becomes irregular in shape, and its surface is pale and flabby, and generally covered with yellowish grey mucus; the edges are not much undermined; very often they are sharply cut and redder than the surrounding parts. The tongue is generally somewhat swollen. The ulcer is superficial at first, but tends to extend more deeply as it increases in size.

Treatment.—This may either be radical or palliative. Radical measures are indicated when the ulcer is small, single, and unaccompanied by advanced

tuberculous disease elsewhere, and is especially applicable to the small ulcers on the tip of the tongue, which cause the patient intense agony on mastication or articulation. It is an open question whether the more extensive tuberculous ulcers, especially when associated with similar disease in the larynx or lungs, should be excised; they are often large, and excision would imply an extensive operation, whilst the cut surface would be very liable to become again infected. When however the disease in the lungs is more or less quiescent, it is of advantage to remove the ulcer even though it be extensive. In any case it is well worth while removing the small and exquisitely painful ulcers.

(a) **Radical.**—The ulcer is best removed by a wedge-shaped excision, the edges of which are accurately stitched together again. It is quite useless to cut out these ulcers and to leave a raw surface, as a second infection would be extremely liable to occur. The operation has been already described (see p. 7), and, before it is undertaken, the mouth and teeth should be thoroughly cleansed. After the operation the usual antiseptic mouth-washes should be employed.

(b) **Palliative.**—This will consist in attempts either to remove the tuberculous surface of the ulcer or merely to relieve the pain and inconvenience in mastication and articulation. Unless the patient be profoundly ill, it is best to make some attempt to remove the surface of the ulcer, and this may generally be done without a general anæsthetic, although the latter is more satisfactory. The ulcer is thoroughly swabbed with a 20% solution of eucaine applied on a small mop, and its surface is then carefully scraped with a small sharp spoon, and afterwards sponged over with undiluted carbolic acid. If necessary, this may be repeated several times until healthy granulation occurs. A mouth-wash of boro-glyceride or sanitas may be used after the operation, and, if healing be delayed, one of alum or tannin (grs. ii.-v. to the oz.) should be substituted. The usual constitutional treatment of tuberculous disease (see Part I., p. 245) should of course be carried out.

When the ulcer is too extensive and the patient is too weak for treatment of this kind, it is sufficient to paint the surface of the ulcer with a 20% solution of lactic acid every day or every alternate day, after which orthoform is powdered on to the ulcer a little before meals, so as to relieve the pain. Should orthoform fail, the local application of a 10% solution of eucaine will be efficient. An antiseptic mouth-wash should be employed frequently, all carious teeth and stumps should be treated, and the patient should be directed to limit the movements of the tongue as much as possible, whilst the food should be soft and free from any irritating spices or similar materials. Plenty of fluid should be taken, so as to wash out the mouth and facilitate swallowing. As an alternative to eucaine in cases where the pain is severe, a small quantity of morphine (a sixth of a grain mixed with a little boracic acid) may be dusted on the ulcer after it has been dried.

CHAPTER III.

NON-MALIGNANT TUMOURS OF THE TONGUE.

The simple tumours that occur in the tongue are rare and several need no consideration. Lipomata and fibromata may be met with and must be enucleated if the diagnosis be made; in any doubtful case it is advisable to cut down and ascertain its nature before performing a set excision, as the simple removal of a non-malignant tumour will suffice for a cure.

NÆVUS OF THE TONGUE.

Nævus of the tongue is not uncommon and may be either *capillary* or *venous*; it is usually unilateral. If small, these tumours may not give rise to any trouble, the only accident to which the patient is liable being hæmorrhage if the growth be injured; as the result of the hæmorrhage there may be septic thrombosis. When however a venous nævus affects a considerable area of the tongue and increases in size, the case is different. Great enlargement of the organ ensues and the tongue constantly gets in the way of the teeth and is wounded, the patient being thus exposed to the risk of serious hæmorrhage and septic infection.

Treatment.—This must vary with the extent and progress of the affection and also with its situation. *When the nævus is stationary and is situated on the dorsum*, there is hardly ever any need for operative interference. The tumour should be watched and operative interference carried out if it increases in size. The best plan then, if the growth be quite small, is to destroy it with the actual cautery at a dull red heat so as to sear the vessels and not to cut through them.

When the nævus is on the side of the tongue and is small, it is constantly liable to be bitten and it had best be excised, even though it be not increasing in size. This can usually be done by a wedge-shaped incision so planned as to go well clear of the dilated vessels. A few ligatures may be required, but as a rule the hæmorrhage is easily controlled when the sides of the wedge are brought firmly together by cat-

gut sutures inserted deeply. Should the bleeding be excessive and impossible to control in this way, the raw surface should be seared with the actual cautery, but this should be avoided if possible because it interferes with healing by first intention. If the incision goes clear of the nævoid tissue in all directions the bleeding is generally trifling.

The serious cases are the *extensive venous nævi* causing a steady increase in the size of the tongue, and immediate treatment is necessary on account of the liability of the organ to injury. Here the only satisfactory method is excision; other methods, such as electrolysis, are inadmissible because of the great danger of septic thrombosis and fatal pyæmia resulting from sepsis spreading along the needle-tracks. Moreover, electrolysis is a very tedious and uncertain method. A considerable portion of the tongue may require removal and it is well to ligature one or both of the lingual arteries as a preliminary, according to the extent of the tumour. This is done as follows:

Ligature of the lingual artery. — The spot chosen for tying the vessel in continuity is usually just after it passes beneath the hyo-glossus muscle. The head is extended upon a suitable sandbag and turned to the opposite side, with the chin pointed upwards as much as possible. A curved incision with a downward convexity reaching almost to the hyoid bone is made from just below the symphysis to the lower border of the jaw at about the anterior edge of the masseter muscle. The flap thus marked out and containing skin, platysma, and superficial fascia is raised and retracted or stitched over the jaw. The deep fascia covering the submaxillary salivary gland is then incised along the lower edge of the latter and the gland defined, raised and pulled up out of the way with a retractor. The guides to the vessel are now sought for. In front the posterior edge of the mylo-hyoid and behind the posterior belly of the digastric are defined and, if necessary, retracted. The anterior belly of the latter muscle with the intervening tendon is also seen and the latter should be pulled firmly downwards. This will show the fibres of the hyo-glossus muscle deep in the wound and the next step is to define the hypoglossal nerve which crosses it horizontally parallel to the hyoid bone. The lingual artery lies beneath the fibres of the muscle between the nerve and the bone. Slightly below the nerve and on the superficial aspect of the hyo-glossus is the vein, which more or less accurately indicates the position of the artery on the other side of the muscle. Vein and nerve are now pulled a little upwards and a transverse incision about half an inch in length is made parallel with the hyoid bone and just above it and the artery thus exposed. This incision must be made with care or the pharynx may be opened. The artery is then isolated and an aneurism needle passed around it from above downwards. The wound is sutured and the ordinary dressings are applied. In the operation great care must be taken to define and raise the sub-maxillary gland efficiently and without wounding it—an accident that might lead to a salivary

fistula. The chief difficulty of the operation lies in finding the vessel beneath the hyo-glossus. If the operator fails to find it there he may trace the hypoglossal nerve backwards until the lingual is seen as it arises from the external carotid.

In spite of this however the bleeding may be profuse, so that, in very extensive cases, it is well to control the circulation by temporary ligatures passed through the substance of the tongue well beyond the excision area. After the larger vessels have been tied, any oozing is easily arrested by firmly-tied sutures inserted deeply through the wound, but occasionally it may be found necessary to apply the actual cautery before the temporary ligatures are removed or even to leave on the latter and allow them to come away by ulceration. In either case of course healing by first intention fails.

If the nature of the operation permits, the edges of the wound (when clean-cut) are brought together by catgut sutures passed deeply through the muscular substance, and a simple antiseptic mouth-wash is used for a few days. The stitches usually do not require removal.

LYMPHANGIOMA OF THE TONGUE.

This is not uncommon and is the usual cause of the condition known as "*macroglossia.*" The typical form of the latter condition is a congenital lymphangioma of the tongue, the lymphatics being dilated much as in a venous nævus. Very often the superficial vessels are also dilated and tortuous and give rise to vesicles on the surface of the organ towards the tip and edges. At first the tongue is quite soft and does not cause much inconvenience, although it occasionally swells and is larger than it should be. The superficial dilated lymphatics however are very easily injured and this is followed by inflammation of the tongue and considerable thickening, and the patient is liable to repeated inflammatory attacks which leave the organ firmer, harder and larger than before. After a time the tongue may become too large for the mouth and is firmly pressed against the teeth of the lower jaw or may even hang out of the mouth permanently. The result of the constant pressure on the lower jaw is a very marked deformity. The alveolar border and the teeth project forwards, and, if allowed to persist, this deformity becomes irremediable. The patient has difficulty in breathing, masticating and swallowing.

Treatment.—The condition is a very serious one and must be treated. In former days various methods, such as igni-puncture, electrolysis, scarifications, etc., were employed, but they never really cure the condition and only serve to set up inflammation and increase the growth of the tongue. The only method which promises success is *excision of wedge-shaped portions* of the organ including as much as possible of the lymphangiomatous mass. These operations are no doubt dangerous and may be followed by severe lymphangitis just as are operations for hydrocele of the neck and other

lymphangiomatous tumours; the more so as the wound is of course a septic one. When however repeated attacks of inflammation have occurred and a typical macroglossia has been produced, the lymphatics are widely blocked already and there is not the same risk of spreading lymphangitis. The condition of the tongue is far too serious to be left alone, notwithstanding the certain amount of risk.

Operation.—Before operation the mouth must be scrupulously cleansed, all fur removed from the tongue, and the teeth scaled and cleaned. A wedge-shaped portion, so planned as to include the greater part or the whole of the lymphangiomatous region and large enough to reduce the size of the organ to its proper limits, should be removed from the tongue, and this should be done as early as possible, before any deformity of the jaw has occurred. The bleeding is not severe and generally stops when the edges are brought together; it will very seldom be necessary to have recourse to the actual cautery. After the operation the wound is brought together by catgut sutures inserted deeply, and antiseptic mouth-washes, such as boro-glyceride or sanitas, are employed frequently.

Other forms of macroglossia, such as muscular hypertrophy and inflammatory enlargement of the tongue, are described but they are not true lymphangiomata. *Muscular macroglossia* is excessively rare and *inflammatory enlargements of the tongue* are never so extreme as to deserve the name of macroglossia.

PAPILLOMATA OF THE TONGUE.

Warts on the tongue are not uncommon and are important mainly because they may be followed by epithelioma. They are usually pedunculated and occur on the dorsum; they may also be met with beneath the tongue in the neighbourhood of the frenum. The warty condition of the tongue associated with leucoma has already been referred to (see p. 6); in this condition the warts are usually sessile and are very liable indeed to be followed by epithelioma.

Treatment.—The removal of warts of the tongue is imperative and is usually quite easy. The best method in all cases is to enclose the base of the wart in an elliptical incision which is carried into the substance of the tongue in a wedge-shaped manner to allow the edges of the wound to be stitched together with catgut afterwards. This small operation is best performed under some general anæsthetic, but, if preferred, local anæsthesia by cocaine or eucaine, which should be applied both locally to the surface and injected into the tongue, may be adopted. The importance of operation in cases of very extensive warty growths in a leucomatous tongue has already been referred to (see p. 7).

CHAPTER IV.

CANCER OF THE TONGUE: SARCOMA AND EPITHELIOMA.

SARCOMA OF THE TONGUE.

Sarcoma has been met with in the tongue both as a primary and a secondary growth, but it is exceedingly rare and its treatment presents no feature differing from that of sarcoma elsewhere. The proper plan is to remove the tumour along with the portion of the tongue in which it is situated.

EPITHELIOMA OF THE TONGUE.

This is the most important disease of the tongue and is a very common and particularly malignant form. The results after removal are almost more unfavourable in the tongue than anywhere else. It is said that from 8% to 10% of all cases of cancer occur on the tongue. A very much larger proportion occurs in males than in females. The most common seat of the growth is the middle and anterior part of the edge of the tongue. It may also occur in the posterior part of the organ but very often is then an extension from the tonsil, the pillar of the fauces or the pharynx.

CAUSES.—Of the causation of lingual cancer nothing more is known than that of cancer in general. Here as elsewhere it is usually ascribed to some form of irritation, and there is no question that *a rough tooth* is a very common exciting cause in a patient predisposed to cancer. *Smoking* is another of the chief exciting causes assigned to the disease and no doubt the constant irritation of tobacco in a susceptible subject plays some part. At the same time we are inclined to think that its rôle has been exaggerated.

VARIETIES.—Epithelioma of the tongue appears in various forms just as does the disease elsewhere. In the great majority of cases it is a rapidly growing and very malignant form. It may occur as a crack or fissure with hard edges, or as a prominent sore on the tongue without

any deep ulceration or outgrowth. Again it may begin as a warty mass with a hard base and edges which increases and forms a cauliflower-like excrescence yielding a foul discharge and characterised by deep ulcerations and fissures in the clefts between the papillomatous prominences. Much more rarely the tongue becomes indurated without any marked ulceration and without being warty, and, in the one or two cases of this variety that we have seen, the disease seems to progress slowly and to approximate more nearly to the atrophic scirrhus of the breast than to the ordinary tuberous rapidly-growing cancer of the tongue.

COURSE.—The cancer is at first superficial and the patient's attention may be drawn to it simply by some slight pain on mastication or articulation. The disease however spreads not only superficially along the tongue but also deeply into its substance, and the muscles soon become infiltrated and there is difficulty in protruding the organ. This is most marked when the disease occurs far back, and in these cases too the pain is most severe.

When the disease is situated on the edge of the tongue or floor of the mouth, it spreads not only on to the dorsum but also along the floor of the mouth and thence to the mucous membrane covering the lower jaw, the periosteum and bone of which is soon affected.

When situated at the back of the tongue, the disease spreads to the mucous membrane of the floor of the mouth, to the tonsil and anterior pillar of the fauces, the pharynx and the orifice of the larynx, while at the same time it extends upwards on to the soft palate; so that in cases of extensive disease of the tongue there may also be affection of the tonsil, fauces and soft palate. In other cases the disease in the tongue apparently spreads to it from a primary focus in the palatal or tonsillar region.

When the disease spreads from the border of the tongue to the floor of the mouth or commences in the latter situation, the disease reaches the lymphatic glands probably at a comparatively early period, and the sublingual glands soon become infiltrated. It is very seldom indeed that removal of the tongue alone, even at a very early stage, arrests the disease altogether; although it may not recur in the mouth, it almost invariably reappears in the neighbouring lymphatic glands.

SYMPTOMS.—These are too well known to require much description. There is difficulty in articulation and mastication combined with dysphagia and excessive salivation, while the mouth is constantly full of a foul discharge. The pain is intense, especially towards the later stages from involvement of the lingual nerve; it is referred to any of the branches of the third division of the fifth nerve and is not only present on eating and speaking but is also bad even when the tongue is at rest.

The glands first affected vary according to the seat of the primary disease in the tongue. In cancer of the tip, the frenum and the anterior part of the floor of the mouth, the submental glands are first affected and after them those in the submaxillary region.

In cancer of the middle of the tongue and floor of the mouth, the submaxillary glands will generally be first enlarged. The submaxillary salivary gland itself usually escapes, but in intimate connection with it there are lymphatic glands which readily become enlarged, so that infection of the former may be thought to have taken place. The disease spreads from the submaxillary glands to those in the anterior triangle, especially in the neighbourhood of the bifurcation of the carotid; sometimes it may skip the submaxillary region altogether and appear first in the anterior triangle. Here it spreads rapidly from gland to gland, upwards along the carotid sheath as high as the parotid region and downwards towards the root of the neck. Equally important to bear in mind is the fact that a rapid spread occurs backwards in the glands under the upper half of the sterno-mastoid muscle.

In cancer of the back of the tongue and the tonsillar region, the disease in the first instance affects the glands in the region of the digastric muscle and thence spreads upwards to the parotid region, downwards along the sheath of the vessels and backwards beneath the sterno-mastoid. The rapid distribution over the whole of these lymphatic areas is an extremely important point to remember in treatment, because mere excision of the enlarged lymphatic mass will almost invariably be followed by recurrence, and in most operations it is not sufficient to remove the chain of glands lying along the carotid; those under the sterno-mastoid must always be removed, especially the group beneath the upper end extending as far up as the mastoid process and as far back as the posterior triangle. Another most important point in the operative treatment is the fact that the affected glands in the early stages are soft and very easily torn, and, until they are examined microscopically, the epitheliomatous disease in them may not be recognisable. If they be roughly handled they very readily tear across, and if this occurs during removal there is very apt to be an infection of the surface of the wound, leading to a rapid diffuse epitheliomatous infiltration of the whole scar. The glands become harder as they enlarge, but when they have attained a considerable size they often soften and break down in the centre, so that fluctuation may be obtained in large epitheliomatous masses in the neck, and mistakes have been sometimes made and the glands have been opened under the impression that they were suppurating, with the result that an epitheliomatous ulceration of the skin has been produced. Cystic degeneration of epitheliomatous glands is extremely common, and must be borne in mind during operation, for if such a gland be torn or punctured and the fluid contents escape into the wound, a similar diffuse epitheliomatous infiltration, with hopeless recurrence of the disease, may occur.

The disease in the glands usually progresses very rapidly, and, if the patient live long enough, the tendency is for them to burst through the skin, which then becomes the seat of epitheliomatous ulceration. Bleeding is very common from these deep ulcers, and may be very severe.

The disease in the tongue usually kills patients who have not been

operated upon within a year, or at the most within eighteen months. The cause of death is usually exhaustion due to gradual emaciation, profuse discharge and hæmorrhage from the ulcer, and difficulty in feeding. The final result is often brought about by a low form of pneumonia. Occasionally there are profuse hæmorrhages from the ulcer in the mouth or in the neck from ulceration resulting from epitheliomatous glands, but these are usually small, and only contribute indirectly to the death of the patient.

TREATMENT.—The treatment, like the treatment of cancer elsewhere, is divided into palliative and operative measures. The first and most important point in the question of treatment is to decide which cases are operable and which are not. Operation upon the growth in the mouth should be practised wherever it is at all feasible, because even though recurrence takes place in the glands and the patient eventually dies of the disease, the termination will be much more easy if the mouth be cleared from the foul poisonous growth which interferes with the patient's taking food, and which is a source of intense agony and discomfort to him.

The choice of cases for operation.—The chief factors that the surgeon has to consider when making up his mind as to the suitability of any given case for operative treatment are the extent and situation of the growth in the mouth, the degree of implication of the glands in the neck and the general condition of the patient. We shall consider these questions in the above order.

The extent of the disease in the mouth only influences the question in so far as the possibility of removing the primary disease completely is concerned. When we consider the terrible sufferings which a patient dying from cancer of the tongue has to undergo, sufferings which are attributable to the foul mass in the mouth, it is obviously the surgeon's duty to attempt the removal of the primary disease in the mouth, even when the area of healthy tissues around the disease is comparatively slight, and where therefore a considerable risk of recurrence must be run. This argument must however not be carried too far, for there can be no object whatever in cutting into the mouth when the extent of the disease is so great that it is obviously impossible to remove it entirely. For instance, should the tongue be more or less completely infiltrated with cancer which has extended so far on to the floor of the mouth as to completely fix the organ, no good whatever can result from operation ; moreover a case of this kind would probably be complicated by very extensive involvement of the glands of the neck.

The situation of the disease in the tongue is of considerable importance. A comparatively extensive growth situated on the anterior part of the organ may be removed with a fair prospect of success when a much less extensive mass in the posterior half must be left alone. Some surgeons hold that extension of the disease from the tongue to the tonsillar region contra-indicates operative interference, but, although it undoubtedly increases the gravity of the operation, we are not inclined to look upon

these cases as of necessity inoperable. We have operated on cases in which the growth has extended as far upwards as the soft palate and on to the pharynx from the base of the tongue on one side and have been able to remove the disease completely. If, however, the whole base of the tongue be involved and the mischief extends across the middle line, the case is undoubtedly better left alone, and we would say that where the growth is situated in the base of the tongue it should be regarded as inoperable unless it be limited to one side of the organ and situated well towards the edge. Removal of the entire tongue base and all is a very serious operation indeed, and is likely to be followed by fatal septic complications. In feeble patients indeed, death may occur at the time of the operation from shock.

When the disease spreads back and involves the orifice of the larynx, particularly the aryteno-epiglottidean fold, operation is contra-indicated. On the other hand, limited epithelioma on the back of the tongue, involving the upper surface of the epiglottis, may be removed, and we have had one case in which the patient has remained well five years after removal of a portion of the base of the tongue and the epiglottis. When however the growth on the tongue is so extensive as to necessitate removal of a portion of the aryteno-epiglottidean fold, the disease will have spread, to some extent at any rate, into the tonsillar region and the pharynx, and removal would leave a large raw surface, the discharges from which will find their way directly into the larynx, so that death from septic pneumonia or acute septicæmia will be almost certain. In fact the only operative possibility here would be to remove both the tongue and the larynx, which is a very severe mutilation and probably one to which few patients would submit knowingly. Extension to the jaw, particularly in the region of the angle, generally renders the case inoperable. If the disease be in the anterior portion of the tongue, provided that it be comparatively limited, it is not however necessarily a contra-indication.

When the glands of the neck are involved, the disease in them is liable to be much more extensive than in the tongue, and it is not at all uncommon to find cases passed as inoperable on account of glandular infection, although the disease in the tongue could be easily removed. In our opinion, up till very recently, surgeons have not been nearly bold enough in the removal of epitheliomatous glands from the neck. It has been customary to teach that glands should not be removed unless they be small and freely movable and that fixation is an absolute contra-indication to removal. Experience has however convinced us that this is much too sweeping a statement. Fixation of the glands in the early stage simply means that they are adherent to the carotid sheath, and the limitation of movement is only in the vertical direction. Numerous operations, both on tuberculous and malignant glands, have shown us that this adhesion to the carotid sheath does not materially complicate the operation for the removal of the glands. If the internal jugular vein, or

sometimes merely the overlying portion of its sheath, be removed systematically in all these cases, the glands can be taken away without trouble. Excision of the jugular vein does not apparently affect the comfort of the patient in any way. The serious difficulty arises when the glands involve the carotid artery, the vagus or both, and under these circumstances the condition may well be looked upon as inoperable. But however fixed the glands appear to be when examined through the skin, it will be found that, provided there be lateral mobility, removal of the jugular vein almost always suffices to allow the disease to be extirpated, and therefore it is of the highest importance to cut down and explore the condition of affairs. Even in apparently hopeless cases, a comparatively slight dissection will show whether removal be feasible or not, and, if the case be found to be inoperable, the wound can be closed without any risk or great inconvenience to the patient. Involvement of the carotid artery and the vagus nerve are comparatively rare unless there be very extensive infiltration of the neck—when the mass will be completely fixed and there will be no lateral mobility—and ligature of the carotid with its serious symptoms of imperfect blood supply to the brain will be therefore practically never called for. Removal of portions of the vagus, on the other hand, does not seem to be attended by any particular danger. It has been done more than once accidentally, and in one case where we found the carotid artery intact but the vagus infiltrated with disease, two inches of the nerve were removed designedly ; although some irregularity of the pulse persisted for two or three days, the patient was none the worse, and in a short time the pulse became regular. At the same time, however, if the disease involves the artery or nerve, we should consider the case inoperable.

Should there be extensive involvement of the glands extending well down into the root of the neck, so that it is obvious that those in the thorax must be affected, or should the glandular enlargement involve the skin, thereby showing that the disease has passed the limits of the gland, operation must be looked upon as out of the question.

Extension of glandular disease beneath the sterno-mastoid, although it makes complete removal much more difficult, does not necessarily contra-indicate operation. On the other hand, extension upwards into the parotid region is a much more serious matter, inasmuch as, owing to the anatomical condition of affairs, the probability of removing all the affected glands in that area is very slight.

The general condition of the patient will influence the decision to some extent. It is very rare for metastasis to occur in cancer of the tongue, although secondary deposits have occasionally been found in the lung. Either the disease does not spread by the blood vessels or else the patient dies before it has had time to establish itself elsewhere; the question of metastatic deposits therefore does not affect the question of operation. But after operation for cancer of the tongue a wound is left which must become

septic, and the chances of recovery must depend to a great extent on the patient's power of resisting septic influences, and therefore his general health becomes a point of great importance. Alcoholics, for instance, stand these operations very badly, more particularly when the area involved is the base of the tongue, and we should certainly say that in habitual drunkards, even though they have no albuminuria or definite visceral disease, it is inadvisable to undertake extensive operations. The result of the operation is frequently to bring on an attack of delirium tremens, and, moreover, the tissues seem particularly unable to resist sepsis, so that the chances of a fatal result are extremely great. In the subjects of albuminuria or diabetes there would be the same hesitation to operate.

Patients who are very feeble, much run down by the disease or semi-starved, will not stand an extensive operation such as the removal of a growth from the base of the tongue or excision of the entire organ, as they are extremely liable to succumb to septic or hypostatic pneumonia. In these individuals therefore, the disease should be left alone, unless it be small, favourably situated, and entailing only a comparatively slight operation. On the other hand, it is often well to give strong, robust men the chance of getting rid of the disease, even though it be very extensive. Should the operation fail and the patient succumb, his life is only shortened slightly and he is saved an immense amount of pain. These patients generally stand the shock of the operation perfectly well, and the result depends more upon the question of the risk of sepsis. As our experience has increased we have found that in various ways these risks may be diminished—a point which will be referred to immediately (see p. 27).

Dangers of the operation and their avoidance.—These dangers may be classified as immediate or remote, the former being shock, hæmorrhage and asphyxia from blood in the air-passages, whilst the latter are essentially those due to sepsis, such as septic pneumonia, acute septicæmia, suppuration among the planes of cellular tissue in the neck and secondary hæmorrhage.

Immediate dangers.—*Shock* has to be guarded against on the lines already dealt with fully (see Part I., p. 139); with regard to this point, careful choice must be made of suitable subjects to stand the operation.

Hæmorrhage during the operation will be dealt with in describing the technique of the operation itself. The question of principle that has to be considered here is whether a preliminary ligature of the lingual arteries (see p. 16) should be performed or whether the vessels should be caught and tied in the mouth during removal of the tongue. The answer depends mainly on the severity of the operation and the amount of the organ to be removed. When the whole tongue is to be excised, it is as well to tie the lingual at any rate on one side before operation. Whenever the neck has to be opened up for the removal of enlarged glands, which should always be done before the disease in the mouth is attacked, the lingual artery should be tied at the same time. It is perfectly easy to

do it, it shortens the later stages of the operation greatly, while it also diminishes the bleeding into the mouth and thus in two ways reduces the shock of the operation. Therefore whenever the conditions allow the lingual to be tied from a wound in the neck, which is necessitated by the presence of enlarged glands *and which will not be made to communicate with the wound in the mouth subsequently* and therefore will not become septic, we have no hesitation in recommending that it should be done.

On the other hand, when an extensive operation in the anterior triangle is necessitated, and this has to communicate freely with the mouth, we prefer to ligature the lingual as it is divided in the tongue, because the whole wound in the neck must necessarily become septic, and the ligature on the lingual trunk near its origin from the carotid is certain to separate, and its separation is very likely to be followed by secondary hæmorrhage. When this occurs, it will usually be about the tenth day, when the patient is otherwise fairly well and is probably not under careful supervision, with the result that he may die before assistance can reach him, death ensuing either from loss of blood or from the blood finding its way into the trachea. In order to stop this hæmorrhage it will be necessary to tie either the external or the common carotid, either of which may be followed by disastrous results,—the ligature of the external carotid probably by secondary hæmorrhage, as it will be tied in a septic wound, and ligature of the common trunk by fatal cerebral symptoms. Under these circumstances, therefore, we prefer to tie the terminal branches of the vessel rather than to ligature it in continuity at its origin.

Asphyxia from the passage of blood into the trachea is usually comparatively easily avoided except when the base of the tongue is involved. The patient should be so placed that the blood flows readily out of the mouth. Whitehead has his patients in a semi-sitting position with the head held forwards so that the blood can run out of the mouth without getting into the pharnyx. Others, and ourselves amongst them, place the patient on the side with the mouth turned a little downwards to the sound side, the lower angle of the mouth being firmly pressed down by an assistant's fingers so that the blood runs first into the cheek and then out of the mouth. In bad cases the risk may be altogether avoided by having the head hanging over the end of the table, much as for cleft palate operations, or by adopting the plan recommended by Keen for laryngectomy, namely, the Trendelenburg position. This avoids the passage of blood into the trachea; but it must be admitted that the comfort of the operator is not enhanced, as there is a certain difficulty in getting properly at the tongue, and furthermore the venous oozing is of course markedly increased. We therefore prefer the position that we adopt for the majority of cases, as it is most essential to the thorough removal of the disease that unrestricted access to the growth should be obtained.

When however the situation of the disease demands removal of the tongue far back, we believe with Kocher that a preliminary tracheotomy is advisable. It really does not add materially to the dangers of the operation, and it has the inestimable advantage of enabling the surgeon to disregard the oozing and to concentrate his attention entirely on the removal of the disease—a point of the highest importance when it is situated as far back as this. The constant sponging necessary to prevent blood running into the larynx is calculated to flurry the surgeon and the result is that he does not cut sufficiently wide of the disease behind and the whole object of the operation is defeated.

Remote dangers.—These are mainly *septic risks* and it is of the highest importance to adopt measures to minimise them. The most serious risk of sepsis occurs in operations about the base of the tongue and in the cases in which there is an extensive removal of glands in the neck which opens up the cellular planes and establishes a direct communication with the buccal cavity.

In the first place, although the operation is done in a septic cavity, the same precautions should be taken to disinfect instruments, hands, etc., as are employed in operations through unbroken skin. Although organisms abound in the mouth, the majority of them are comparatively harmless and it is well to avoid the risk of introducing other more virulent ones from without.

A point of importance is to diminish the amount of sepsis present in the mouth before operation. These cancerous ulcers are often excessively foul, and there is much putrid material not only on the surface of the sore but also between the teeth and in the folds of the mouth, and during removal of the tongue this may extensively soil the cut surface. Hence for two or three days before the operation special attention should be directed to the hygiene of the mouth. The patient should use antiseptic mouth-washes, such as boro-glyceride (ʒj to the oz. of water) or a strong sanitas solution very frequently. The teeth should be scaled and cleaned and the folds between the gum and cheek and gum and tongue should be mopped out thoroughly with antiseptic lotions. It is on and between the teeth that the septic material mostly accumulates, and this accumulation is facilitated by the fixity of the tongue so often present. It is well to put the patient into the dentist's hands a few days before operation.

At the time of the operation the ulcer itself if very foul should be painted over with undiluted carbolic acid before any incision is made. Care, of course, must be taken to prevent the acid from coming in contact with the healthy mucous membrane, and the tongue should be pulled as far out as possible. The teeth, floor of the mouth and gums should be thoroughly swabbed with a 1-2000 sublimate solution.

We have employed preliminary injections of the antistreptococcus serum (see *Practitioner*, April, 1897) with the view of diminishing the risk of sepsis. The chief organism concerned in septic troubles after these operations is the streptococcus pyogenes and it would seem that the best method of dealing

with it is to employ the serum beforehand, so as to render the patient less susceptible to its attacks rather than to wait until it has gained a footing in the tissues. Hence we are accustomed in all cases of operation upon the mouth and jaws of any severity to employ injections of the serum for a couple of days before the actual operation. A full dose of 30 cc. is injected 48 hours before the operation and doses of 10-15 cc. are given subsequently every 12 hours. We have never seen any harm result from this treatment and we are of opinion that there is less sepsis and sloughing of the wound than was the case before we employed it. To some extent no doubt this may also be due to the more careful cleansing of the mouth now practised. At the same time we are inclined to look upon the administration of the serum as a useful precaution.

Another way of diminishing the sepsis is by planning the operation so that part if not the whole of the wound in the mouth may be subsequently closed in. It used to be the custom to leave a large raw surface after removal of half or the whole of the tongue, which necessarily became the seat of extensive septic infection, so that it is not surprising that in many cases the organisms spread into the cellular tissue between the muscular planes and gave rise to serious constitutional disturbance. If these wounds in the mouth can be closed they heal very readily, and therefore we always attempt to arrange the incisions so that part of the wound at any rate can be stitched up. This is done by dividing the tissues somewhat obliquely so as to leave small flaps of mucous membrane above and below which can afterwards be approximated by catgut stitches. A very considerable amount of mucous membrane can often be saved in this way and we regard it as a precaution of the highest importance in all cases in which the wound is made towards the root of the tongue and the tonsillar region where the accumulation of putrefying discharges is extremely prone to give rise to septic pneumonia. Of course in the majority of cases it is impossible to stitch up the wound completely, but even an imperfect closure, especially towards the back of the throat, not only diminishes the risks of sepsis but also enables the patient to swallow and to move the tongue much better than he otherwise could. Another important point is that if a flap can be got to cover in the wound in the region of the tip of the tongue the binding down of the organ to the floor of the mouth with its consequent interference with speaking and swallowing which otherwise occurs is very markedly diminished.

Another very useful precaution against sepsis is to swab out the wound and all its recesses very thoroughly with a solution of chloride of zinc (grs. 40 to the oz.). This has the effect of closing the routes of absorption to a considerable extent and thus delaying the onset of sepsis.

The septic troubles are chiefly cellulitis, acute septicæmia and septic pneumonia. In our opinion many cases of the latter affection are really acute septicæmia, and this is the reason why we lay such great stress upon all the local precautions that it is possible to take. Directly septic pneumonia is established there is practically nothing to be done as the

disease is most fatal. The treatment of this affection has already been dealt with (see Part V., p. 241).

How to deal with the glandular area.—In operations for cancer of the breast not only must the primary tumour be removed, but the entire glandular area in the axilla and the lymphatic tracts between the tumour and the glands must also be cleared away. The question arises whether this should also be done in cancer of the tongue. In the breast not only will the glands in the axilla be infected, but there are almost invariably plugs of cancerous cells in the lymphatics running from the breast to the glands; were the latter alone removed, the disease would be very apt to recur in the lymphatic vessels, especially over the pectoral fascia. This infection of the lymphatics themselves does not seem to take place however to anything like the same extent in cancer of the tongue. It is a very remarkable fact that these large cancer cells can apparently traverse the lymphatics without becoming arrested on the way, and it is usually only in advanced cases that there is an infection of the lymphatic tract between the tongue and the glands. Hence it is not always necessary to remove the tissues between these two structures, in other words to cause the wound in the mouth to communicate with the triangles of the neck. This is a very fortunate matter on account of the serious risk of sepsis which would otherwise have to be incurred. In the early stages at any rate, it is safe to leave the lymphatic tract between the tongue and the anterior triangle untouched.

Another question of importance is whether the fat and glands should be removed from the anterior triangle as is done in the axilla, when no glandular enlargement can be felt at the time of the operation on the mouth. It is now an established rule in cancer of the breast that the entire contents of the axilla, fat and glands together, should be cleared out, whether enlarged glands can be felt or not. Should this also be done in cancer of the tongue when no glandular enlargement can be made out? Theoretically of course it would be best, but practically we think there are considerable disadvantages in doing so. In the first place, the area is not so well defined as is the case with the axilla. The lymphatic area is very much more extensive (see Figs. 14 and 15), and the affection of the glands may extend in a variety of directions, namely, upwards into the parotid region, downwards along the course of the vessels, or backwards beneath the sterno-mastoid, and the disease may sometimes apparently skip the nearest group of glands. Not only is the area very extensive, but the glands are not easily removed when not enlarged, and it is not easy to clear the region from all the fat and glands when the latter are not markedly enlarged. The glands are not at all easily defined and some are almost certain to escape, particularly those along the sheath of the vessels, in the upper part of the parotid region and beneath the sterno-mastoid above the spinal accessory nerve; moreover, it must be remembered that only one complete and satisfactory

operation is possible in this region. If once the anterior triangle has been opened up for the removal of glands and recurrence takes place it is practically impossible to remove that recurrence satisfactorily. The dissection of this region is one requiring great skill and care, and, if it be complicated by a mass of cicatricial tissue which distorts the parts and mats together the various structures, it is practically impossible to find one's way so as to completely clear the glandular area. Hence, if the triangles have to be opened and the glandular area removed, it must be done thoroughly and once for all, and our experience is that this can be effected very much better if there be a certain amount of glandular enlargement present. The enlargement acts as a sort of guide, and we prefer to deal with these cases rather than those in which there is no glandular enlargement at all; in the latter we usually remain satisfied with simple removal of the disease from the mouth, followed at a later period by a second operation which will be necessary for the excision of the glands, as they are practically certain to be involved sooner or later. In opposition indeed to the opinion generally held, we consider that the removal of malignant glands from the anterior triangle in cases where the disease is not extensive is a most satisfactory operation, and we have many cases of this kind in which recurrence has not taken place.

Should enlargement of the glands be dealt with at the time that the disease in the tongue is removed?—As a rule it is better to complete the whole operation at one sitting when the glandular enlargement is not very marked. The effect of a second severe operation a few days after the first is sometimes markedly deleterious to the patient and therefore, unless there be some particular difficulty in the operations or unless the glands be very extensive, there is no objection to performing them both at one time. The surgeon would of course begin by removing the glands in the neck; this is an aseptic operation and, when completed, the wound is stitched up and covered with dressing before the disease in the mouth is attacked. When removal of the disease in the tongue does not involve a communication with the dissection in the neck, it is well to tie the lingual artery in the latter situation, as it is fully exposed in removing the glands, it does not demand any extra time and it shortens the operation in the mouth very greatly as the disease there can be readily clipped out without any fear of bleeding.

The cases in which this question assumes its greatest importance are those of advanced disease either in the neck or in the tongue. Removal of the glands in bad cases such as would formerly have been deemed inoperable (where the jugular vein is involved and the disease extends up into the parotid region and beneath the sterno-mastoid) is a prolonged operation and patients with disease so advanced as this are generally weakly and liable to shock. Moreover, should the disease in the mouth be extensive, its proper removal will probably necessitate a communication between the floor of the mouth and the dissection in the neck, and acute sepsis in

the planes of the neck is most likely to occur. In these cases we think it well to divide the operation into two stages, allowing a week to elapse between each, and the question then arises as to which operation should be performed first, the removal of the tongue or that of the glands. The answer will depend on the part most affected. In bad cases such as these, the process usually spreads much more rapidly in the glands than in the tongue and it will generally be found advisable to remove the glands in the first instance and to leave the excision of the tongue to a later period. It is only when the disease in the mouth is very extensive and the glandular affection comparatively slight that the reverse procedure is advisable.

THE OPERATIONS UPON THE TONGUE.

We shall consider first the methods for the removal of the disease in the tongue and afterwards those for the extirpation of malignant glands from the neck. Many operations have been recommended for cancer of the tongue, and different cases require different methods, the particular one employed depending partly on the situation and partly on the extent of the disease. When the latter is limited to the anterior part or the border of the tongue, a much less severe form of operation will be required than when it is situated posteriorly in the neighbourhood of the pillars of the fauces, and, similarly, much less severe measures are necessary when there is only superficial disease and the growth has not yet penetrated into the deeper muscles of the tongue than when the latter are deeply infiltrated.

Another point is how much of the tongue it is necessary to remove. When the disease has not extended into the deeper muscles, it is often sufficient to take away only the affected area along with a suitable amount of healthy tissue around. In this way a great part of the organ can be preserved and its usefulness not materially interfered with. When the disease is well to the side, the tip of the tongue may be left intact and this is a matter of much importance for the subsequent power of articulation. On the other hand, when the disease has penetrated well into the muscles, one half of the tongue at least must be removed right back to the base, because the lymphatics run for the most part parallel with the muscular fibres, every movement of which forces on lymph along them, so that a muscle infected by cancer should be looked on as diseased throughout its entire extent and removed as freely as possible.

The procedures that may be adopted for the removal of the tongue are (1) the intra-buccal methods; (2) those in which assistance is gained by splitting the cheek or dividing or even partially excising the lower jaw; and (3) removal of the organ through incisions made beneath the jaw. The choice between these methods will be influenced largely by the extent and situation of the disease. The procedure that we shall adopt here is to describe the various operations that are suited for removal of disease in particular situations in the tongue.

1. When the disease is superficial and is limited to the tip of the organ.—Here a V-shaped excision of the tip of the tongue will often be sufficient.

V-shaped excision of the tip of the tongue.—The position of the patient in this operation will vary according to the fancy of the operator. We prefer to have the neck steadied upon a sandbag, with the head somewhat dependent over it and turned well over to one side. Others have the head propped up so as to allow the blood to run out of the front of the mouth. A Smith's gag without a tongue-plate or Lane's gag (see Fig. 1) is used to prop the mouth open, and the assistant is provided with plenty of sponges on sponge-holders and is instructed to press down the angle of

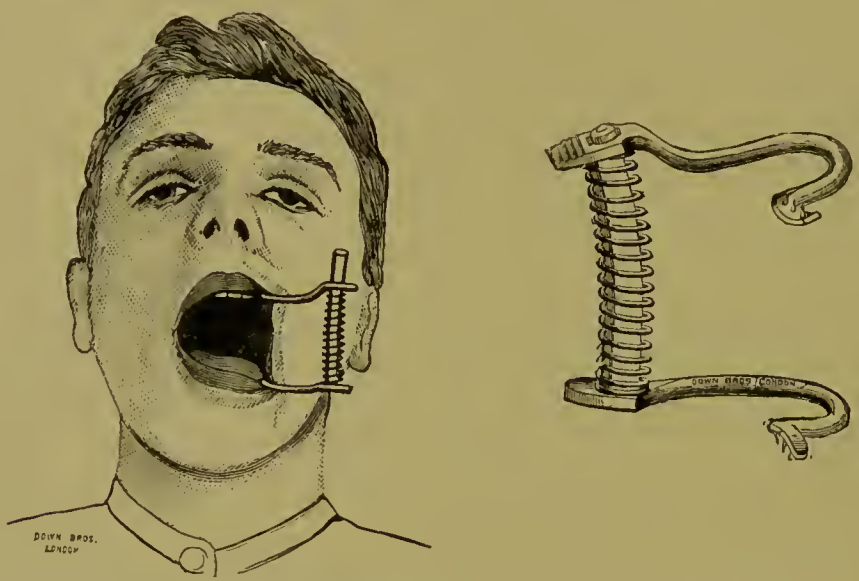


FIG. 1.—LANE'S GAG. The small spikes on the arms of the gag stick firmly into the alveoli and prevent the gag from slipping.

the mouth firmly on the side towards which the head is turned in order to allow the blood to run out freely. A stout silk thread is passed through the base of the tongue on each side so as to pull and hold the whole organ well forward. Unless these ligatures be inserted well back they will not pull the tongue forward satisfactorily; if inserted through the tip, as is commonly done, they merely stretch that part of the organ without pulling forward the whole of it. The best way to introduce the ligatures is to pass the finger over the dorsum of the tongue into the space on either side of the median glosso-epiglottidean fold and then to pull up the front part of the tongue forcibly and to thrust a nævus needle armed with stout silk through the under surface of the tongue as far back as possible well through its base, bringing it out where the finger lies in front of the epiglottis. This gets good purchase on the tongue and brings it as far forward as it will come. The threads are then entrusted to an assistant who pulls them well forward and so steadies the whole tongue. A pair of tenaculum-forceps is inserted into the portion of the tongue to be removed, which

is thus pulled forward and steadied. The frenum is now divided with a pair of long sharp-pointed scissors so as to allow the tip of the tongue to come still more forward, the division however stopping short of the ranine artery. A V-shaped incision is made through the mucous membrane (see Fig. 2) with the scissors well wide of the growth; if preferred, the V can be marked out on the mucous membrane with a knife before proceeding to the further stages of the operation. The central portion of the tongue is then cut out with a few snips of the scissors, careful watch being kept for the ranine arteries at the lower part as the incision is deepened; they are easily seized and do not give rise to any trouble as they quickly stop on pressure or after torsion. The portion of the tongue external to the incision may be steadied by grasping it with catch-forceps while the central portion is being cut out.

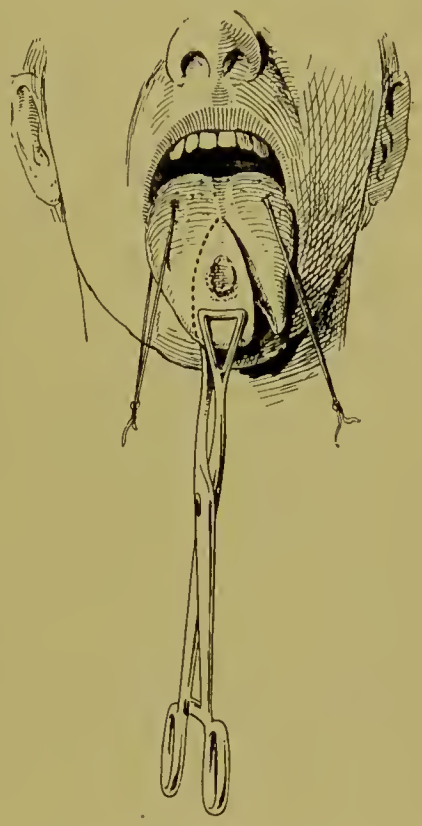


Fig. 2.—V-shaped Excision of the Tip of the Tongue. The chief object of the sketch is to show how the sutures introduced through the base of the organ hold the tongue firmly forwards. As the V-shaped incision is made, the tip of the portion remaining on each side is steadied with catch-forceps. The frenum linguæ is freely divided in order to allow the tongue to come properly forward.

All that now remains to be done is to bring together the sides of the V and approximate them with catgut sutures inserted deeply into the substance of the tongue so as to bring the raw surfaces everywhere into apposition, to check the oozing and to prevent the formation of a cavity. It is well not to apply a dressing to the wound nor any application of any kind; the use of iodoform or chloride of zinc might interfere with union by first intention and it is quite sufficient to make the patient use some simple antiseptic mouth-wash frequently after the operation. He can usually be allowed to get up in the course of two or three days and is well in about a week. The diet for this time should be fluid or semi-fluid and as bland as possible. In taking food, the area of the operation must be avoided as much as possible and the food introduced into the mouth somewhat far back and to one side by means of a rubber tube attached to the spout of a feeder.

2. When the disease is superficial and situated at the side of the tongue.—Here a partial operation may often be done. The tongue is pulled forward by ligatures inserted as described above (see p. 32), the tip is seized in tongue forceps and pulled well to the opposite side and a portion of the organ in the neighbourhood of the tumour is excised so as to leave the tip of the tongue intact. The portion removed may be either

quadrilateral, extending well up to the raphe, or it may be wedge-shaped according to the extent of the disease. When a quadrilateral portion is removed, it is well to save as much of the mucous membrane as possible and to dissect it up somewhat from the floor of the mouth, so that, after the operation is completed, it may be stitched to the mucous membrane on the dorsum.

When a wedge-shaped portion has been removed, stitches are inserted so as to approximate the sides of the wedge; although this deflects the tip of the tongue to one side, it has the great advantage of rapid closure of the wound; deflection of the tip of the tongue is inevitable under any circumstances, and, as the tip accommodates itself to its position subsequently, the functional result is excellent.

It is only comparatively rarely that these partial operations can be employed; at the same time we feel that possibly they are not practised quite as frequently as they might be and that it is too much the routine to excise half of the organ when less would suffice.

3. When the disease is fairly extensive but is limited to one side of the tongue and is not absolutely at its base.—The great majority of these cases are quite well dealt with by an intra-buccal operation. The fundamental type of this operation is that introduced by Mr. Walter Whitehead of Manchester and commonly called by his name. Various surgeons have modified the steps of the operation and we shall here describe the one we are accustomed to perform. It differs from Whitehead's original operation merely in a few slight details.

Whitehead's operation.—The patient lies with the shoulders well raised on a sandbag and the head turned fully over to the sound side.[1] The mouth is widely opened with a self-retaining gag such as Lane's (see Fig. 1), which does not slip, takes up very little room and is applied far back on the sound side so as to get the angle of the mouth well open and thus to allow the blood to collect in the cheek and then to run out of the mouth. A large retractor at the opposite angle of the mouth pulls the cheek well back so as to expose the buccal cavity thoroughly. A good light is essential and the patient should either face a window in bright sunshine or artificial illumination must be used. The anæsthetic should be chloroform and should be administered either upon an open inhaler or by a Junker's apparatus provided with a nasal tube. A stout silk ligature is passed through the base of the tongue on the sound side in the manner just described (see p. 32) and another is inserted through the tip of the half that is to be removed (see Fig. 3). The surgeon takes charge of the latter, while the former is entrusted to an assistant whose duty it is to pull the tongue well forward and to keep the mouth sponged well out; he should be provided with plenty of sponges on holders or forceps. The steps of the operation will vary somewhat according to

[1] Mr. Whitehead operates with the patient's head propped up and bent forward so that the blood shall run out of the mouth instead of flowing into the pharynx.

whether the disease does not encroach at all upon the floor of the mouth or whether there is actual or threatening invasion in the latter situation.

When the disease does not encroach at all upon the floor of the mouth, the simplest plan is to split the tongue in the first instance along the raphe right back to the base. A very easy method of doing this is to cut through the mucous membrane in the middle line either with a knife or by inserting one blade of a pair of sharp-pointed scissors beneath the mucous membrane in the middle line and running it back to the base, dividing the mucous membrane as it goes. When the mucous membrane has been similarly divided on the under surface of the tongue the organ can be split by seizing one half in each hand and tearing the muscular fibres apart; splitting the tongue in this manner by tearing rather than by incision saves considerable bleeding. Then, beginning in front at the frenum, the surgeon with a pair of blunt-pointed straight scissors divides the mucous membrane and the muscles in the floor of the mouth on the affected side by a series of short snips proceeding from before backwards taking care to divide the mucous membrane as near the tongue as the limits of the disease permit and not to open up the cellular planes in the floor of the mouth. As the division proceeds, the half of the tongue to be removed is drawn forward by the silk thread through it, so that the growth comes more and more forward and the operation is performed almost outside the mouth. The anterior pillar of the fauces is snipped through and this allows the tongue to come still more forward. The removal of the affected half of the organ is completed by making a transverse incision across the affected half well behind the limits of the growth. In the first instance the incision is carried through the mucous membrane, and then the muscular fibres are divided. Among the latter the lingual artery will be met with; as a rule it is quite easy to identify it and secure it in forceps before it is divided, but, should it spout, it is quite easily secured in the wound, as the remainder of the tongue can be easily pulled forward by the suture passed through the base on the sound side, and the source of the hæmorrhage thus seen and secured. Should there be any difficulty in seizing the bleeding vessel, it is well to remember that the hæmorrhage can be temporarily arrested by slipping the forefinger back to the root of the tongue, hooking it well forward and pressing firmly outwards against the angle of the jaw.

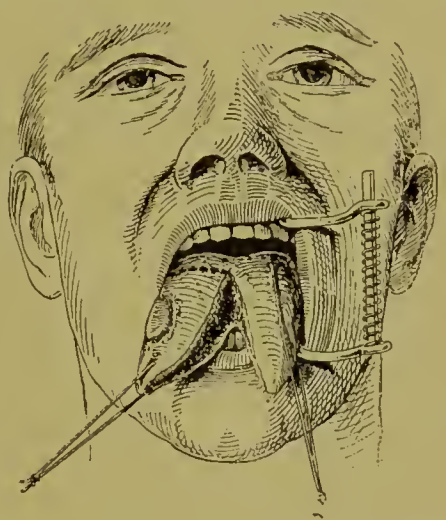


FIG. 3.—REMOVAL OF ONE HALF OF THE TONGUE BY THE INTRA-BUCCAL METHOD. A suture is inserted through the tip of the half to be removed, and another through the base of the opposite half. The tongue is split in the middle line and the dotted line indicates the transverse incision well behind the growth. A retractor should be used to pull back the angle of the mouth on the right side.

When however the disease tends to encroach upon the floor of the mouth, the operation should be modified somewhat. In the first place the frenum is freely divided with scissors; unless the disease be situated near the tip of the tongue, the frenum may be divided quite close to the organ; otherwise it should be snipped through near the jaw. The scissors are now introduced beneath the mucous membrane of the floor of the mouth and run along beneath it as near to the side of the tongue as the situation of the disease allows until the anterior pillar of the fauces is reached. This structure is snipped across and, when this has been done, it will be found that the tongue can be brought out quite freely so that the operation becomes largely extra-buccal. The tongue is split in the middle line (*vide supra*) as far back as the base, and the affected half is drawn well forward and the muscles on the floor of the mouth are cut through as before. In these cases it is necessary of course to cut deeper into the floor of the mouth and it is always well, when there is any tendency to encroachment of the disease in the latter situation, to shell out the sub-lingual salivary gland. As a rule the lingual artery is met with far back in dividing the muscles in the floor of the mouth. It can often be identified and secured before division but if it spouts it is easily secured, as pulling the tongue well forward causes the blood to spurt well up out of the mouth and to expose the source of bleeding. After the lingual has been secured all that remains to be done is to detach the half of the tongue by a few transverse snips of the scissors in the region of the base.

The operation is accompanied by a variable amount of oozing, which may persist for some little time after the half of the tongue is removed. There is, however, very little true arterial bleeding, and practically all hæmorrhage is permanently arrested as soon as the lingual has been controlled. It is well, therefore, not to take much notice of the bleeding, and to proceed rapidly with the operation, trusting to the fact that when the lingual is secured and the organ removed the bleeding will cease. It is the assistant's duty to see that no danger arises from the presence of blood in the mouth.

After the operation, the mouth is thoroughly sponged out, any flaps of mucous membrane that have been saved are brought together by catgut stitches, and the wound in the mouth freely sponged out with a chloride of zinc solution (40 grs. to the oz.), taking care to see that the patient does not swallow any of it. No application to the raw surface beyond the chloride of zinc is necessary. It is especially important if possible to suture the mucous membrane on the dorsum to that on the under surface of the tip of the tongue, so that the latter can be kept free and is not bound down in the floor of the mouth. It does not matter much if there be considerable tension on the edges of the flaps of mucous membrane brought together in order to diminish the raw surface in the mouth. Adhesions will form even if the stitches cut their way through, and some diminution at any rate will take place in the size of the wound during the early stages of repair, when there is the greatest risk of sepsis. Of course the stitching of the wound in the

mouth must be done judiciously. It is possible, for instance, to make the tongue unduly long by suturing the mucous membrane over the raw surface too far back, while, on the other hand, if no suturing be practised the raw surface beneath the tongue and that on the floor of the mouth will adhere, so that the organ is tightly bound down and articulation is much interfered with.

The suture is removed from the base of the sound half of the tongue and the patient is put back to bed, with the head turned well over to the affected side and the mouth somewhat dependent, so that any blood may readily escape. As soon as the anæsthetic is recovered from, the patient may be propped up into the sitting position, and is generally able to get about in three or four days. The details of after-treatment will be described after the various other operative procedures have been discussed (see p. 47).

4. When the disease extends beyond the middle line, but is limited to the tongue, the entire organ will require removal. Some surgeons recommend that this should be done by removing one half at a time, but in connection with this it must be remembered that such a procedure will involve an incision through the cancer, and this is bad practice, for fear of infection of the wound, and therefore the organ should be removed as a whole. This is the operation which should strictly be called Whitehead's operation, and is described by him as follows:[1]

"The ligature passed through the anterior portion of the tongue is a great aid throughout the operation, and much depends upon the dexterity of the assistant in anticipating the intentions of the operator, and in always making traction in exactly the right direction, his aim being to make tense those tissues which are immediately to be divided.

"The first step in the actual operation consists in the separation of the tongue from its attachment to the floor of the mouth and the anterior pillars of the fauces, and I would lay stress upon the way in which this is done, because the ease with which the operation is continued depends largely upon the freedom with which this separation is carried out. The two structures principally responsible for the retention of the tongue within the mouth are the frenum and the anterior pillars of the fauces; and, if these are completely divided in the first instance, the tongue may be so freely drawn from the mouth that the operation is practically converted into an extra-oral excision. Extended practice has made me conduct this part of the operation with less deliberation and more rapidity than was my habit in my earlier cases. Instead of the cautious snipping I originally advocated, I now boldly cut until I get close to the vicinity of the main arteries, disregarding all bleeding, unless an artery distinctly spurts, when I twist it and proceed. The more profuse the general oozing the more rapidly I proceed, my object being to get as quickly as possible to the main arteries, as I have confidence that all subsidiary bleeding will cease immediately after their division. There is, in reality, no difficulty in determining the actual position of the lingual arteries, as they are practically invariably found in the same situation, and it requires

[1] *British Medical Journal*, 1891, vol. i. p. 962.

very little experience to seize them with a pair of forceps before dividing them; if this be done there need not be the slightest hæmorrhage from this source. When once the vessels are effectually twisted, the rest of the tongue may be removed without any further anxiety about hæmorrhage; but it is desirable, before finally severing the last attachments, to pass a loop of silk through the glosso-epiglottidean fold, as a provisional measure of security, in case it may become necessary to make traction on the posterior floor of the mouth either to assist respiration, or to arrest any possible consecutive hæmorrhage. Traction on this ligature of itself arrests hæmorrhage, and makes it an easy matter to secure any bleeding vessel. As the retention of this ligature is a source of some annoyance to the patient, I always remove it at the end of twenty-four hours. As a matter of fact, I cannot recollect its having been required in more than two cases, and but for the certain sense of confidence it gives to those who are left in charge of the patient I should dispense with the precaution altogether were I influenced solely by the amount of benefit I have derived from its use.

"The treatment of the floor of the mouth after the tongue has been removed is a matter of considerable moment. The first object is to make the cut tissues as far as possible aseptic, and for this purpose I am still in the habit of swabbing the parts with a mercurial solution, and, after drying, finally painting the surface with the iodoform styptic varnish which I introduced in 1881. This preparation, in addition to its antiseptic properties, has the advantage of lessening the discomfort which follows when the surface is left unprotected, and it also enables the patient to take food in the ordinary manner almost immediately after the operation.

"The mercurial solution I prefer is that of the biniodide, and the strength I am in the habit of using is $\frac{1}{1000}$. I have recently made, and I think with advantage, a slight addition to the iodoform varnish. My original custom was simply to substitute for the spirit ordinarily used in the preparation of friar's balsam, a saturated ethereal solution of iodoform, but now I prefer to mix with the ether one volume in ten of turpentine. This addition has a very marked influence in promptly checking the capillary oozing which occasionally prevents a dry surface being quickly secured.

"I was at one time in favour of suspending all alimentation by the mouth for the first four days, and feeding the patient entirely by nutrient enemata; but for some years I have entirely abandoned this practice, and I now feed the patient with liquids, by the mouth, as freely and as early as possible, only using enemata when it is necessary to supplement the amount of food the patient is otherwise able to take; and I find that if a coat of the varnish is applied daily, patients rarely have any difficulty in taking an adequate amount of sustenance. It fortunately happens that the patients appreciate rather than object to the application of the varnish, and they will often ask for its use more frequently than once a day."

The ligature at the base of the tongue should either be fastened to the teeth or kept hanging out of the mouth by the weight of a pair of forceps.

5. When the disease extends from the base of the tongue to the surrounding structures.—Cancer affecting the base of the tongue in the region of the pillars of the fauces with extension on to the floor of the mouth so that the tongue cannot be protruded owing to widespread cancerous infiltration of the muscles cannot well be treated by intra-buccal operations; they are very apt to fail in removing the disease completely and some means must be adopted for getting better access. Everything is to be gained by free exposure of the disease. Hesitation to adopt any means to this end on account of deformity, etc., is unjustifiable. It is not a question of merely removing the cancer from the mouth. Anyone can do that. It is

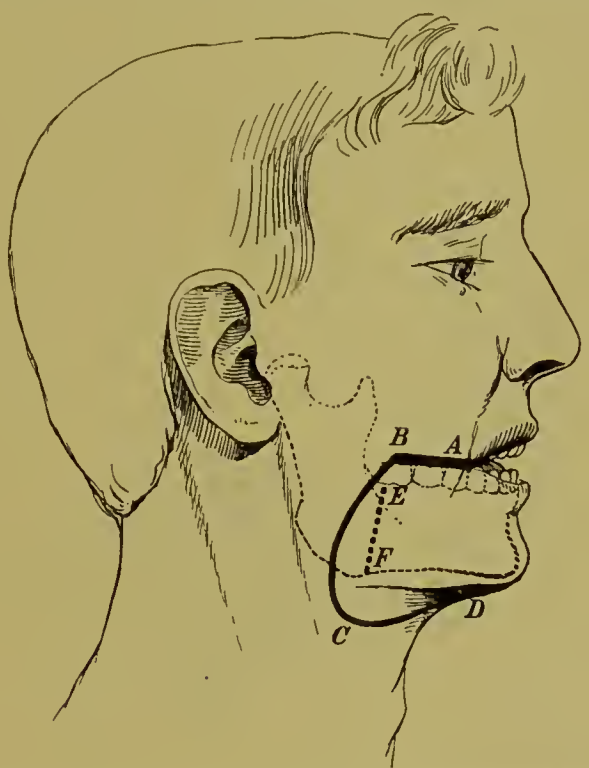


FIG. 4.—LANGENBECK'S DIVISION OF THE JAW. The thick line *AB* represents the splitting of the cheek, the curved one, *BCD*, the flap from the face and chin, while the dotted one, *EF*, shows the line of division of the jaw.

important to get well beyond it, so as to avoid the chance of local recurrence, and this can only be done by obtaining a thorough exposure of the parts to be operated upon.

Splitting the cheek.—The simplest way of facilitating the operation is to split the cheek backwards from the angle of the mouth to the anterior margin of the masseter, and this is the method especially suitable for cancer in the neighbourhood of the anterior pillar of the fauces. The assistant grasps the whole thickness of the cheek above and below the line of incision and the entire thickness of the cheek is then divided back to the masseter (see Fig. 4, *AB*). The facial vessels are twisted and any other bleeding points are arrested. The edges of the aperture thus made are well retracted, so that

a good view of the base is obtained when the tongue is pulled over to the opposite side. The parts come still further into view in the course of the operation when the mucous membrane and the pillar of the fauces are divided. Splitting the cheek in this manner is very essential to success, as otherwise there is great risk of cutting too close to the growth behind. The deformity, particularly in men, is inconspicuous, and union always takes place readily.

Division of the jaw.—In more extensive cases, when the base of the tongue is widely infiltrated, and particularly when the floor of the mouth and the tonsillar region are encroached upon, considerable help is obtained by dividing the jaw in addition to splitting the cheek in the manner recommended by Langenbeck (see Fig. 4). The cheek is split as before, and when the anterior margin of the masseter is reached, the incision is curved



FIG. 5.—LANGENBECK'S METHOD OF EXCISING THE TONGUE. The divided ends of the jaw are pulled forcibly apart and good access is obtained to the side of the tongue and floor of the mouth. The incision is the same as that shown in the preceding figure.

down across the jaw into the neck and it is well to prolong this incision forwards over the hyoid bone curving it upwards towards the symphysis, so that a flap is raised and any glands in the submaxillary region can be dissected out. The jaw is then divided at the level of the last molar, and the anterior portion is pulled firmly forwards and outwards, whilst the posterior part is pulled outwards; this gives very complete access to the floor of the mouth (see Fig. 5).

Langenbeck's incision, if prolonged along the hyoid bone and curved upwards towards the chin, gives very good access to the submaxillary region, so that not only can the whole affected portion of the tongue or the entire

organ itself be removed, but the submaxillary salivary and lymphatic glands and all the structures in the floor of the mouth can freely be exposed. The jaw can readily be brought together afterwards by one or two silver wires of medium thickness. If the growth clearly does not affect the jaw, the holes for the wires may be drilled before the bone is divided, but, when there is any doubt, it is well not to do this, as the drill holes may be infected with cancer cells and it is only slightly more troublesome to drill them at the end of the operation. By splitting the cheek and dividing the jaw and so performing an operation which is partly intra- and partly extra-buccal the entire tongue can be readily removed right back to the base if necessary. Moreover the anterior triangle can also be cleared of glands at the same

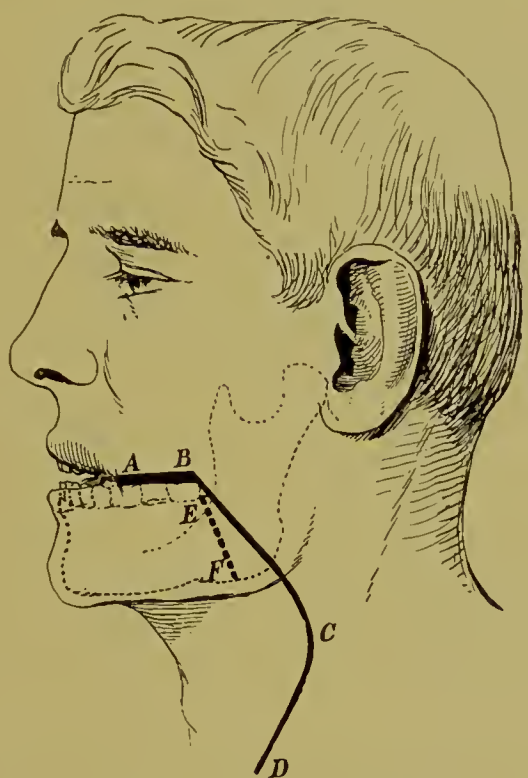


FIG. 6.—LANGENBECK'S DIVISION OF THE JAW WITH EXPOSURE OF THE ANTERIOR TRIANGLE. This is similar to the preceding figure except that the incision *BCD* is prolonged down the margin of the sterno-mastoid instead of being curved up towards the symphysis.

time by carrying the incision well back to the anterior margin of the sterno-mastoid and then prolonging it down the edge of that muscle (see Fig. 6).

If it be found that the disease encroaches upon the lower jaw itself, it will be necessary to remove a portion of the bone. As we have already said (see Part V., p. 223), it is very important to try to avoid removing the entire depth of the bone and, while it is still more undesirable to merely peel off the periosteum and remove it in these cases, an attempt may be made to save some portion of the thickness of the jaw so as to retain the proper form of the bone.

6. When the disease spreads extensively over the floor of the mouth and markedly involves the jaw the whole of the infected portion of bone must be removed. The risk of recurrence must not be run by being too sparing in the removal of the bone.

Partial excision of the jaw.—When the disease is situated towards the front of the tongue, spreads over the floor of the mouth and also affects the ramus of the jaw, the best plan is to make a curved incision with its convexity downwards, commencing close to the symphysis, running down nearly to the hyoid bone and curving upwards to the neighbourhood of the angle of the jaw (see Fig. 7). This flap, with all the soft tissues on the outer

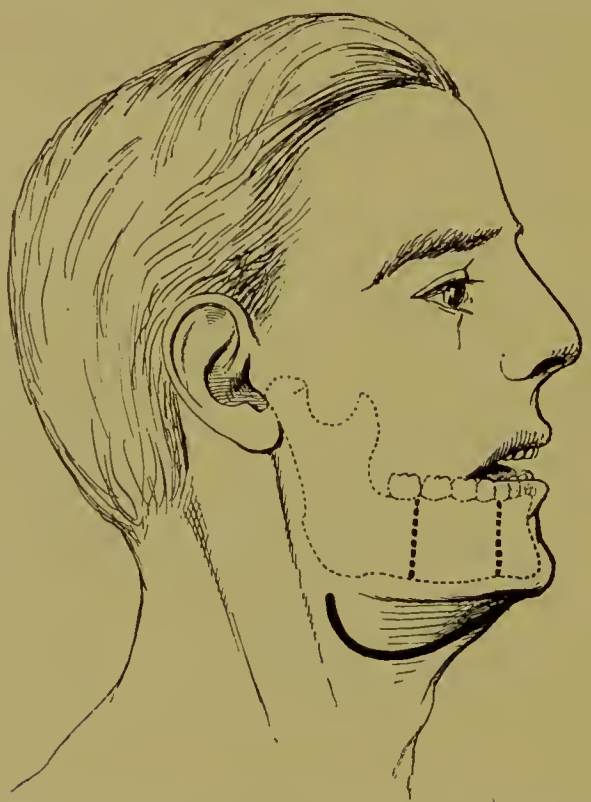


FIG. 7.—INCISIONS FOR REMOVAL OF THE TONGUE AND A PORTION OF THE JAW.
The continuous line indicates the skin incision, the dotted ones the section of the jaw.

surface of the jaw, is then turned well up, the bone is cleared, the mucous membrane over the jaw is divided in front and behind well clear of the disease, the necessary teeth are extracted and the jaw is sawn through in front and behind as close as is safe to the limits of the disease. The divided portion of the jaw is now left attached to the tongue, while the glands in the submaxillary region, which are generally infected, are dissected out and the lingual artery tied as it passes beneath the hyoglossus muscle. The mouth is then opened with a gag and the rest of the operation done by intra-buccal excision. The mucous membrane of the floor of the mouth is divided in front of the disease, the anterior pillar of the fauces is snipped through and the tongue split along the raphe. The flap is then turned well up,

the mylo-hyoid muscle divided, and a view of the interior is easily obtained by pushing the detached portion of bone out of the way. The disease can then be clipped out, the sublingual gland being removed with the affected half of the tongue and the floor of the mouth.

The wound in the mouth is sponged over with chloride of zinc solution (40 grs. to the oz.) and is lightly packed with iodoformed gauze which emerges through an aperture left in the incision in the neck. The treatment of the defect in the jaw must follow the lines already laid down (see Part V. p. 226).

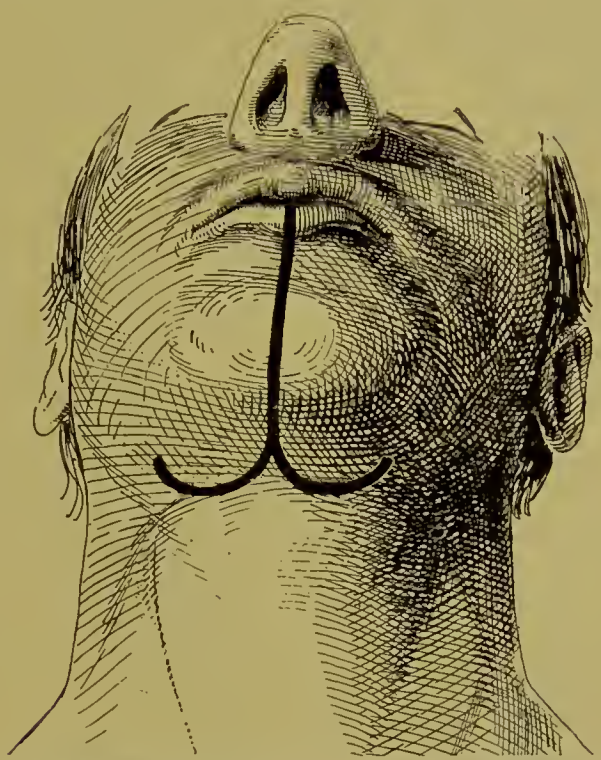


FIG. 8.—SYME'S EXCISION OF THE TONGUE. The sketch shows the method of curving the incision away on each side as it nears the hyoid bone, so as to raise flaps and remove glands. Syme used a simple median incision.

Various other operations may be required when the disease in the tongue is very extensive or when it affects the floor of the mouth and other parts.

When the anterior portion of the floor of the mouth in the neighbourhood of the symphysis is affected so that the front of the tongue and the frenum are matted together, the operation known by the name of Syme or that recommended by Regnoli may be performed.

Syme's operation.—This operation (see Fig. 8) is done by splitting the lower lip vertically in the middle line and carrying the incision down to the hyoid bone. It will often be found advisable to carry curved incisions outwards to each side from this point so as to expose the sides of the tongue more freely. One of the central incisor teeth is then extracted and the jaw is sawn through the socket of that tooth (*i.e.* just to one side of the middle line), the soft parts separated and the two halves of the jaw pulled forcibly apart so as to expose the whole of the anterior portion of the floor of the mouth and the tongue. The rest of the operation is carried out with scissors, the mucous membrane being divided well free of the growth on either side and well back to the pillars of the fauces which are also divided. The tongue muscles are snipped through close to the hyoid bone and, as this proceeds, the anterior portion of the organ will be loosened and the tongue can be pulled

forward, and a thread passed through its base so as to hold it well forward after the disease has been removed. The whole of the affected area is then clipped out with scissors and the bleeding points are tied or clamped as they are met with.

After the bleeding has been stopped, the raw surface should be diminished as much as possible by catgut sutures, the two halves of the jaw wired together and the thread through the stump of the tongue fastened either to the teeth or to this wire. This is absolutely essential, as the muscles running from the tongue to the hyoid bone have been freely divided and the stump will otherwise fall back and cause dangerous asphyxia. It must be remembered that in the course of a short time the stitch may cut its way through the base of tongue, and this may occur before the parts are sufficiently consolidated to dispense with its use. It is usually required for three or four days and in any case where there is doubt as to the possibility of the suture holding it is well to perform a tracheotomy so as to avoid this risk. This is especially necessary in cases that are not in hospital, and in any case the



FIG. 9.—REGNOLI'S OPERATION. If the horns of the incision be brought well down towards the hyoid bone good access to the parts is obtained.

attendant should be constantly at the bedside and should have suitable forceps with which the stump can be seized and pulled forwards if necessary.

When the disease actually implicates the jaw itself, a portion of the bone in the region of the symphysis will require removal. As in the operation just described (see p. 42) the bone should be sawn through on either side of the disease but left attached to and removed in one piece with the growth in the tongue. For treatment of the bone see Part V., p. 227.

Regnoli's operation.—This operation (see Fig. 9) is suited for cases in which the cancer is situated on the anterior part of the tongue and floor of the mouth, but does not affect the jaw, as in it the bone is left intact. A curved incision with its centre opposite the symphysis is carried along the lower border of the jaw, curving downwards at each end towards the hyoid bone, so that a large flap can be turned down in the submental region as far as the hyoid bone to thoroughly expose the structures beneath the tongue. A suture is passed through the tip of the tongue, and the mylo-hyoid and the other muscles in the region of the symphysis are divided. The limits of the growth are then carefully ascertained so as to see how near to the jaw the mucous membrane must be divided. This can be done readily

by introducing a knife from the wound in the submental region into the buccal cavity and the mucous membrane is divided close to its attachment to the jaw well back to the fauces on either side. This leaves an opening through which the tip of the tongue can be pulled out beneath the chin (see Fig. 10). Before doing this it is well to divide the genio-hyo-glossi muscles to whatever extent it may be necessary to enable the tongue to be freely pulled out without necessitating any further division of them afterwards. The tongue being pulled forcibly forwards through the opening, the removal of the growth is performed with scissors, the lingual arteries being caught as they are divided.

Kocher's operation.—This is a well-known operation, but for our part we generally prefer Langenbeek's division of the jaw (see p. 40) as by it a much better view of the parts is obtained with much less trouble than by Kocher's operation, which is far too severe to be employed for cases short of those in which the entire organ has to be excised. At the same time it will occasionally be necessary to perform the latter and we therefore describe the steps of it.

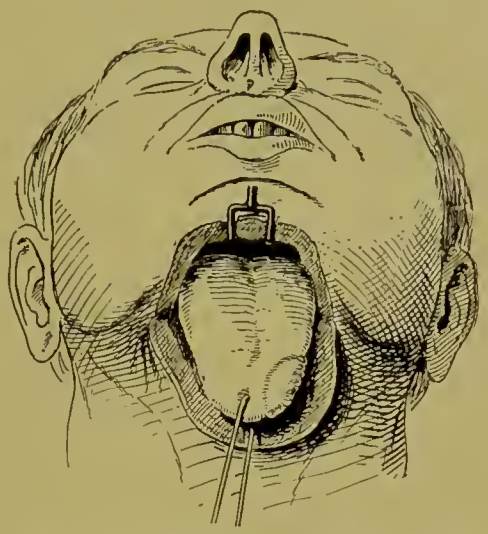


FIG. 10.—REGNOLI'S METHOD OF EXCISING THE TONGUE. The front of the organ can be easily dealt with from the submental opening. The incision is shown in the preceding figure.

In a typical Kocher's operation a *preliminary tracheotomy* is necessary so as to enable the pharynx to be plugged with sponges. This prevents blood getting into the air passages and also does away with the risk of the epiglottis falling back over the larynx after the entire tongue is removed; when the base of the tongue is removed the larynx will almost certainly become blocked unless a preliminary tracheotomy be done.

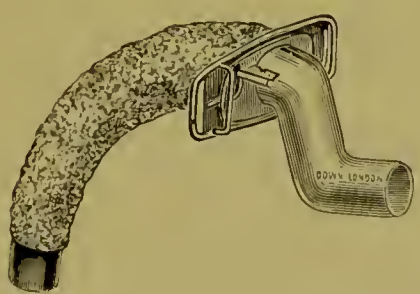


FIG. 11.—HAHN'S CANNULA. The tube is packed round with sponge. For the method of preparing it see Part V., p. 260.

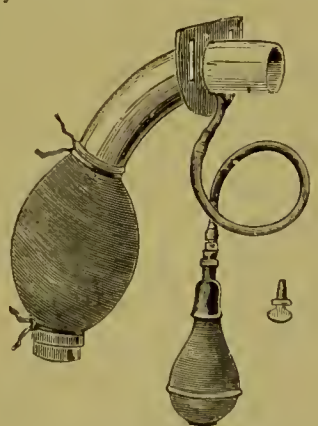


FIG. 12.—TRENDELENBURG'S TAMPON CANNULA. The blocking of the trachea around the tube is done by an inflation apparatus.

After the tracheotomy tube has been inserted—which should preferably be a Hahn's or Trendelenburg's (see Figs. 11 and 12)—the shoulders are raised on sandbags and the head is allowed to hang somewhat downwards and turned towards the side upon which the disease is least extensive. The incision (see Fig. 13) commences at the symphysis and sweeps downwards and somewhat backwards to the hyoid bone. It is carried along parallel to the latter structure backwards nearly to the anterior margin of the sterno-mastoid and then sweeps upwards and backwards over the anterior border of this muscle to near the lobe of the ear.

In Kocher's operation, as usually described and figured, this incision is angular, but it is much better if it be made with the large curve here described. The flap of skin and superficial fascia thus marked out is turned up over the jaw, the deep fascia over the anterior triangle and the submaxillary region divided and the glands removed, the submaxillary triangle being especially thoroughly cleared. In order to remove the entire glandular area from the anterior triangle it may be necessary to continue the incision along the border of the sterno-mastoid downwards to the level of the cricoid cartilage.

The mylo-hyoid muscle is now divided, leaving nothing between the wound in the neck and the mouth but the mucous membrane. The latter structure is next divided from before backwards on the side of the operator and the anterior pillar of the fauces is clipped across. To do this it is necessary to open the mouth with a gag, and when it has been done the tongue can be drawn out through the wound in the neck.

The later steps of the operation depend upon whether the whole or only one half of the organ is to be removed, as in the latter case it is well to split the tongue in the middle line



FIG. 13.—KOCHER'S INCISION FOR REMOVAL OF THE TONGUE. The dotted line shows the direction in which the anterior triangle may be opened up if necessary.

along the raphe from inside the mouth (see p. 35). When the entire organ is to be removed, the mucous membrane and the anterior pillar of the fauces on the other side should be divided from inside the mouth, the mouth shut and the lower jaw forcibly pulled up with a stout retractor whilst the tongue is pulled out through the wound in the neck. This thoroughly exposes the whole lateral area and base of the tongue and the affected portion is easily clipped away with scissors well wide of the disease. The arteries are seized and tied as they are divided.

There is no doubt that this is a very excellent method for complete extirpation of the tongue. When the disease infiltrates the muscles right down to the hyoid bone, it is very easy to leave some portion of it behind in any other operation, whereas in Kocher's the whole muscular mass is exposed and the excision can be carried as far back and as low down as may be necessary. But at the same time it is only for those cases where the infiltration extends far back or deep down and where the whole of the organ has to be removed right back to the hyoid bone that the operation is essential. Kocher himself spoke of it as an operation that could be carried out antiseptically. This of course is not possible. At the

same time, however, the sepsis is more or less superficial and possibly may be kept under control by packing the mouth wound with antiseptic gauze, and it is as much to enable the wound to be packed in this way as to prevent blood getting into the trachea at the time of the operation that a tracheotomy is desirable.

Dressings.—After the tongue has been removed, the surface of the stump is sponged with a solution of chloride of zinc (40 grains to the oz.) and the wound is firmly packed with cyanide or iodoform gauze. Caution must be observed in using the latter because several cases of iodoform poisoning have occurred. The external wound is stitched up and one or more drainage tubes are inserted, passing from the most dependent parts of the mouth wound into the neck so as to carry off all discharge freely. The Hahn's tube is removed and either a fresh one is inserted for 24 hours or an ordinary tracheotomy cannula is substituted according to whether or not there is much likelihood of discharges finding their way through the glottis.

After-treatment of operations upon the tongue.—After the disease has been removed and the hæmorrhage arrested, the raw surface should always be swabbed with a solution of chloride of zinc (40 grs. to the oz.), care being taken that none of the solution runs down into the pharynx. The chloride of zinc is allowed to penetrate into all parts of the wound, which is opened out for the purpose, and if this be done carefully it will be found that the immediate sepsis is less and that septic decomposition is sometimes delayed sufficiently for the wound to become covered with inflammatory exudation, and thus to be more or less protected.

The next point is to diminish the size of the wound in the mouth as far as possible by stitching together the cut edges of the mucous membrane with catgut. In all the operations on the mouth, as we have already said (see p. 36), every available portion of sound mucous membrane should be dissected up and saved, with the view of carrying out this reparation at the end of the operation. From the nature of things the suturing of the mouth wound will be very irregular, and it does not much matter if there be considerable tension upon the sutures, as, if even the stitches cut through, adhesions will have formed and a considerable diminution will be effected in the size of the wound during the early stages, and the greatest risk of sepsis thus overcome.

There is considerable diversity of opinion as to the best method of treating the wound after the operation. Some surgeons dust the raw surface freely with iodoform, but this is a dangerous procedure, because a wound of this kind requires a large quantity of iodoform, and absorption of the drug from the mouth is always very free, and a large number of cases of very severe iodoform poisoning have undoubtedly occurred. It is probable that the patient actually swallows a considerable quantity. Whitehead has introduced a special varnish (see p. 38) which he applies immediately after the operation and renews on subsequent occasions. We have tried it, but we cannot say that we have seen any particular good result. Kocher packs the mouth full of gauze and allows the patient to breathe through a tracheotomy tube; again we cannot say that we have seen any real advantage in the way of asepsis result from this. Our

own plan is rather to interfere as little with the wound in the way of dressings as possible. As soon as the patient can employ them, antiseptic mouth-washes are frequently used. Before that time we are accustomed to simply allow the discharges to be expectorated or to drain from the mouth, facilitating their removal occasionally by gently spraying or syringing the raw surface with lotions of chlorate of potash or bicarbonate of soda, and the nurse is instructed to thoroughly cleanse the teeth and to brush them well with an antiseptic mouth-wash such as strong boro-glyceride or sanitas. When there is a drainage tube passing from the wound in the mouth through an opening in the neck, the syringing and spraying of the mouth can be practised very freely from quite an early period, as the fluid readily finds its way out through the tube. The latter should be so arranged that its end projects into the cavity of the mouth for at least three or four days so as to prevent the possibility of discharges accumulating on the raw surface. It may then be shortened so as to allow the opening in the mouth to close gradually.

The point of greatest importance is the *feeding*, and we are strongly of opinion that it is well to trust entirely to rectal feeding for two or three days, especially after the more severe forms of operation, unless the patient be very debilitated. This is done not because the patient is necessarily unable to swallow, but because food is apt to collect in the wound in spite of the greatest care, and such substances as milk and beef tea decompose very rapidly. This is a trouble that can hardly be avoided, and we are therefore most careful to guard against the introduction of any putrescible substance into the mouth. The patient will do perfectly well for three or four days with alternate rectal enemata and zyminised suppositories every two hours, the bowel being washed out daily with a large warm-water enema. Of course, should the patient's condition demand it, feeding by the mouth must be had recourse to, but this should be done as little as possible and should be combined with the use of rectal alimentation. The wound should have granulated fairly completely and be more or less protected against infection before food is taken by the mouth.

If mouth feeding be necessary from the first, it should be done by means of a tube attached to a feeder; a long soft rubber catheter—No. 14-16—will do very well. This should be slipped down one side of the pharynx into the œsophagus, and the fluid poured slowly along it so as to allow the patient time to swallow. It is quite unnecessary to pass a large tube into the stomach, as the above method is quite satisfactory and the larger tube will be sure to disturb the patient. After the food has been administered in this way, the meal may be finished by pouring half an ounce of lotio boracis into the feeder and down the rubber tube, so as to clear out the last few drops of milk or beef tea, and thus to avoid fouling the wound in the mouth as the feeding tube is withdrawn. The mouth should also be thoroughly rinsed out or sprayed with an antiseptic solution immediately after the

meal. The only thing actually allowed in the mouth should be a little ice if the patient complains of thirst or the mouth feels dry.

At the end of the first twenty-four hours the patient should have a saline purge, *e.g.* one and a half ounces of mist. alb., administered through the tube in the same way. All these patients swallow a certain amount of blood either at the time of the operation or afterwards, and this is apt to disorder the digestion; by giving a purge it is got rid of and the patient made comfortable. It is also a good plan to give salol in 10-grain doses three times a day for the first three or four days; it tends to prevent decomposition and may be made up with a small quantity of mucilage of tragacanth so that it adheres to the raw surfaces.

As soon as the patient recovers from the effects of the anæsthetic he should be propped up in the sitting position with the head bent well forwards in order to facilitate the escape of discharges from the mouth. It will generally be found that by the second day the patient sits up naturally, and, unless the operation has been very extensive, he can usually get up on the fourth or fifth day, and in any case should be encouraged to do so as soon as he feels inclined. Recovery is usually very rapid where no unfavourable complication arises, so that by the end of a fortnight or three weeks the patient is practically well. He should, however, be kept under close observation for three weeks from the time of operation, because secondary hæmorrhage may occur at any time up to then; it is most common from the tenth to the sixteenth day after the operation, when the lingual trunk has been tied in a wound communicating with the mouth.

The question of recurrence.—Should recurrence occur in the mouth, the question of the feasibility of further operation will entirely depend upon where it is situated and its extent. Frequently it is only a small mass at one end of the cicatrix and is then best removed by simply cutting out the affected area with scissors and going over it freely with the cautery. On the other hand, it may occur in the depth of the wound amongst the remains of the muscles of the tongue and may be inoperable. No special rules can be laid down for these cases, but the case must be carefully watched, the patient being seen every three or four weeks for several months, so as to detect the recurrence at the earliest possible period. The thermo-cautery is a very effectual method of removing recurrence in the superficial parts, partly because it causes little or no bleeding, whereas the cicatricial tissue, being extremely vascular in the early stages, oozes freely when removed with the knife or scissors, and partly because, as the cautery burns its way through the diseased area, the tissues around are charred, so that much more is destroyed than would be removed by the knife; moreover the seared surface does not so readily become the seat of septic infection as a raw one would.

THE OPERATIONS UPON THE GLANDS.

Glands enlarged secondarily to cancer of the tongue occur very early and in various situations, such as the submental or the submaxillary region, the anterior triangle or above the digastric muscle. Wherever they first appear, they soon spread along the carotid sheath and extend backwards



FIG. 14.—THE SUPERFICIAL LYMPHATICS AND GLANDS OF THE HEAD, FACE, AND NECK. (Gray's *Anatomy*.)

under the sterno-mastoid particularly in the neighbourhood of the mastoid process. A glance at Figs. 14 and 15 will explain the distribution of the various glands in these regions. We have already pointed out (see p. 29) that it is necessary to remove not only the glands actually enlarged but also the whole area of glandular tissue and, in dealing with the anterior triangle in particular, the operation must not be limited to the triangle itself but must extend in all directions, particularly backwards beneath the sterno-mastoid muscle as far as the posterior triangle.

1. Removal of glands from the submental region.—Glands appear here especially frequently in disease of the anterior portion of the floor of the mouth, chiefly when it is in the immediate neighbourhood of the frenum. The glands are felt directly below the symphysis and just above the body of the hyoid bone. They are mainly superficial, but



Fig. 15.—The Deep Lymphatics and Glands of the Neck and Thorax. (Gray's *Anatomy*.)

it must be remembered that some are present beneath the genio-hyoid muscles.

The best incision for removing these glands is a curved one parallel with the lower border of the jaw and about half an inch below it (see Fig. 16). The flap thus marked out is thrown downwards, the deep fascia over the genio-hyoid muscles is exposed and it and the glands are thoroughly removed; the genio-hyoid muscles are then separated and the

fat and glands beneath them taken away. When the tongue is being operated upon at the same sitting, it is best to begin by removing the glands and then to proceed to the operation upon the tongue.

2. Removal of glands from the submaxillary region.—Enlarged glands in this situation are common when the disease is situated well forward in the lateral region of the tongue or the floor of the mouth. In the latter cases the sublingual salivary gland is also involved. The glands in the submaxillary region are readily cleared out by turning up a flap made by carrying an incision from just on the affected side of the symphysis down to the hyoid bone and curving it upwards to just below the angle of the jaw (see Fig. 17). The flap containing skin, superficial fascia and platysma is turned up and the deep fascia covering the submaxillary region is exposed. When this is divided, the submaxillary salivary



FIG. 16.—INCISION FOR THE REMOVAL OF THE SUBMENTAL LYMPHATIC GLANDS.



FIG. 17.—INCISION FOR THE REMOVAL OF GLANDS FROM THE SUBMAXILLARY REGION.

gland comes into view and large lymphatic glands in its neighbourhood are at once found. Glands will also be found beneath the jaw running outwards towards the angle and one or two may be met with in intimate connection with the facial vessels. Although the submaxillary salivary gland itself is not usually affected except by direct extension, it is almost always advisable to remove it because the affected lymphatic glands are very intimately adherent to its sheath and may sometimes lie actually amongst its lobules, so that, unless the salivary gland be removed, lymphatic glands are very likely to be left behind. Another and highly important reason for removing the gland is that the orifice of its duct is very likely to be interfered with by the operation in the mouth and subsequent stenosis, with a painful swelling and possibly suppuration of the gland, may occur. This may not only be a serious source of annoyance to the patient but

may be actually mistaken for recurrence of the growth. The facial vessels are tied as they cross the jaw and the deep fascia passing from the jaw over the salivary gland is divided along the bone as far back as the angle of the jaw and just above the hyoid bone below. The fascia is pulled down above, the finger is carefully insinuated between the lower jaw and the upper edge of the submaxillary gland and this structure together with the fat and glands connected with it are carefully pulled down, taking care not to perforate the mucous membrane of the floor of the mouth. Any enlarged glands running backwards from the submaxillary to the angle of the jaw are also detached from the bone and the whole mass is peeled carefully downwards and forwards. The facial vessels are then seized and divided before they reach the gland, and the anterior portion of the submaxillary as it passes beneath the mylohyoid muscle is gradually shelled out along with its duct. The latter should be ligatured before division and cut short. The whole of the glandular area can thus be removed in one mass. Should the operation upon the glands be done as a preliminary to treatment of the disease in the mouth, the surgeon can if he chooses proceed to ligature the lingual artery in its continuity, as it will be exposed in the dissection. The wound is closed and dressed in the ordinary manner and the disease in the mouth is dealt with separately unless it be of such a nature as to demand a communication between the wound in the mouth and that in the neck, in which case the wound in the latter situation is left open until the end of the operation, when a large drainage tube is inserted through it into the most dependent spot in the mouth and the rest of the incision is brought together with a few interrupted silkworm gut sutures.

3. **Removal of glands from the anterior triangle.**—This is the situation in which the enlarged glands are chiefly found, and the one in which the greatest thoroughness is essential, for it must always be remembered that, if the glands be imperfectly removed and recurrence occurs, it is practically impossible to perform a second operation satisfactorily. The first operation therefore cannot be too thorough.

These glands are in intimate relation with the sheath of the jugular vein, and at quite an early stage it is difficult to separate the two structures. At a later period the vein is usually so mixed up with the mass of glands that it is excessively difficult to remove the latter without injuring the vein. The main enlargement occurs in the neighbourhood of the bifurcation of the carotid, but the glands run right upwards to the parotid and, when the disease is situated at the back of the tongue, special care is necessary in removing the glands and lymphatic vessels which cross in front of and behind the digastric muscle. In this region also the glands extend outwards under the sterno-mastoid, and are usually divided into two main groups by the spinal accessory nerve. The upper and posterior mass bulges beneath the muscle and is intimately connected with the deep fascia over the deeper muscles in the neck where it extends on to the atlas, and

this fascia must be divided above in order to allow of thorough removal. We have already laid stress (see p. 21) upon the great importance of taking care not to rupture the glands in removing them for fear of epitheliomatous infiltration of the wound, and therefore all incisions should be very free, and the glands should be thoroughly exposed before any attempt is made to get them out. There should be no attempts to pull enlarged glands out of deep recesses when an increase in the length of the incision or a further dissection will enable them to be removed without risk. And, lastly, no attempt whatever should be made to shell each individual gland out, but the whole of the tissues in which the gland is lying must be removed *en masse*. Attempts to shell out soft glands will generally lead to their rupture; should such an accident happen, the best thing is probably to wash out the wound with a 1-2000 sublimate solution and then, opening up the whole surface, to carefully rub it over with undiluted carbolic acid. We have had accidents of this kind, and in one or two cases have avoided the occurrence of infection by this method; but it must be confessed that at other times it has failed us, probably because the carbolic acid did not reach some portion of the raw surface. The actual steps of the operation are as follows:

In the first place certain guides are necessary to perform the operation systematically as it should be performed. It is not sufficient simply to cut down on an enlarged gland and to remove it with some of the tissue around. The first guide is the anterior border of the sterno-mastoid, which must be exposed throughout the whole area. The second is the jugular vein, which should always be exposed below the glandular mass. The third is the spinal accessory nerve. The incision through the skin should always be free, and no attempt should be made to avoid scarring the neck. In all cases where there is a mass of glands in the anterior triangle, an incision should be made commencing about the level of the lobule of the ear and running down along the anterior border of the sterno-mastoid well below any glandular enlargement, usually to about the level of the cricoid cartilage; it should curve somewhat inwards towards the larynx at its lower end. This incision will generally expose the parts freely, and can be extended lower if necessary (see Fig. 18). Should there be enlargement of the glands in the submaxillary region also, a second incision can be carried forwards over that area at right angles to the first. If there be also considerable enlargement of the glands beneath the upper part of the sterno-mastoid, it may be advisable to carry an incision backwards at right angles to the main one near its upper end, and even to divide the muscle itself about an inch or so below its insertion into the mastoid process in order to get thoroughly at them.

The single oblique incision described above is carried through the skin and platysma until the margin of the sterno-mastoid is exposed throughout. The external jugular vein will be met with above and should be clamped in two places and divided. The cutaneous nerves cannot well escape division. The anterior edge of the muscle is exposed by opening the

layer of deep fascia covering it, and the superficial structures, skin, fat and platysma, comprising the anterior edge of the incision, are dissected well forwards leaving the deep cervical fascia untouched. Should the glands be very prominent, care should be taken to avoid cutting too near them. The skin and fat are now pulled firmly forward by suitable retractors and the surgeon proceeds to define the internal jugular vein below the enlarged glands. A vertical incision is made through the deep fascia just in front of the anterior margin of the sterno-mastoid at the lower end of the wound and the vein is exposed almost immediately with the handle of the knife. In our opinion it is advisable in almost all these cases to remove the vein because its sheath is always involved in the disease and, if the vein be



FIG. 18.—INCISIONS FOR THE REMOVAL OF ENLARGED GLANDS IN THE NECK. The thick black line is the main incision along the anterior margin of the sterno-mastoid muscle. The lower end of it may be curved a little inwards towards the middle line if desired. The anterior dotted line is for exposure of the submaxillary region, the posterior one for gaining access to enlarged glands beneath the sterno-mastoid and in the upper part of the posterior triangle.

left behind, infected portions are very apt to remain with it. Moreover it is frequently inextricably involved in the glandular mass, and efforts to dissect off the glands are very likely to lead to tearing of the vein wall and to most annoying bleeding which may seriously interfere with the success of the operation. Removal of the vein is absolutely necessary also in all cases where the wound communicates with the mouth and requires drainage; unless taken away, the vein becomes bathed in septic discharges and is usually pressed upon by the drainage tube, and septic thrombosis is very likely to occur. When the vein has been exposed below the glandular mass, it is isolated, clamped in two places and divided between. The lower end may then be ligatured whilst the upper portion is pulled well forward and the finger is gently insinuated between it and the artery and

the vagus, separating it gradually upwards together with the whole mass of glands, fat and fascia. This separation is continued until the mass is free of the artery and the nerve and is carried as far forward as the submaxillary triangle and as far upward as the parotid. The mass, with the finger kept in position behind it, is then pushed well backwards, and the deep cervical fascia is divided with a knife well in front of the mass from the submaxillary triangle above, downwards along the side of the larynx. This part of the operation will be accompanied by fairly free hæmorrhage and several important vessels may be divided, such as the thyroid, lingual and facial veins; these should be clamped as they are cut. The mass is now free below and in front and can then be turned backwards. This will expose the digastric muscle above, and the relation of this structure to the affected area is noted. When the disease in the tongue is far back, the glandular enlargement often involves the muscle, or at any rate will occur both above and beneath it, and special care must be taken to remove all the fat and glands from its vicinity. Should the muscle itself be involved there need be no hesitation in removing it.

The jugular can now be secured above the main glandular mass by turning it well backwards and insinuating an aneurysm needle around the vein so as to ligature it in two places and divide it between.

The next point demanding attention is the spinal accessory nerve. The glandular mass is replaced in position, pulled well forward, and the knife is carried through the deep layer of the sheath of the sterno-mastoid just along its edge and the parts detached from the muscle with a dissector until the nerve comes into view. We have never found any difficulty in ascertaining its position, as the handle of the knife or the dissector stripping off the fascia from the under surface of the sterno-mastoid generally causes sufficient irritation of the nerve to lead to contraction of the muscle. The spinal accessory usually runs right through the mass of glands, but we have rarely found it actually infiltrated. It generally runs in a channel between the glands, and may be easily isolated by slipping a probe along this. Great care is necessary in getting down to and opening this canal to avoid cutting through cancerous glands, and the surgeon should work well from the outer side. The most difficult part is to clear the glands above the nerve when there is much enlargement in this situation as the glands tend to spread into and beneath the parotid and the upper part of the sterno-mastoid. Luckily there are few important structures in this region and free removal is unaccompanied by danger. The best plan in bad cases is to carry an incision backwards at right angles to the original one about an inch and a half below the mastoid process. The skin is dissected up on either side for a short distance and the sterno-mastoid is divided, leaving enough above to enable the ends to be stitched together afterwards. As the division of the muscle proceeds, the incision must be very cautiously deepened because glands are very often adherent to its under surface. Should this be the case, portions of the muscle

must be excised so that the knife does not go too near to the gland. The lower end of the muscle is now thrown down and the upper part drawn up, when a good view is obtained of the tissues beneath. The limits of the affected area are now clearly defined and all that is necessary is to divide the fascia behind and above it. Behind, the incision is deepened until the splenius capitis and the other muscles are exposed, and the fascia attached to the atlas is divided. The whole area of glands and soft tissues can then be lifted off the deeper parts and pushed down in one mass.

The lower end of the sterno mastoid is now thrown downwards and backwards, and all the fat, fascia and glands below the spinal accessory are removed right back into the posterior triangle. The glands are usually not markedly enlarged in this situation, and are readily peeled down with a blunt dissector or the finger.

When the entire affected area has been thus removed, the wound is thoroughly examined to see that all that is necessary has been done, and if this be the case all the structures in the anterior triangle of the neck should be easily seen. The carotid and its branches, the vagus and the sympathetic should all be visible, and the two former structures should be pulled aside to see whether there be any enlarged glands behind them. The spinal accessory nerve is also seen, as well as the digastric muscle and the various structures in the submaxillary region. The under surface of the sterno-mastoid should show, stripped bare of its fascia, and the deeper muscles of the neck should also be seen devoid of their fascial covering. When the sterno-mastoid has been divided it should be united with catgut in the ordinary manner (see Part II., p. 200).

If done in this way, there should be no recurrence after operations for cancerous glands in the neck and this is now our experience. Instead of the recurrences which were formerly frequent, we seldom have recurrence in the region operated upon at all. Of course recurrence may occur further back in the posterior triangle or in the submaxillary region when the latter has not been cleared. In some cases also recurrence may occur in the parotid.

After-treatment.—This is practically the same as the after-treatment in the other cases. When the wound does not communicate with the mouth no drainage tube is required. The incision is closed by a continuous suture and the ordinary antiseptic dressings are applied, a large mass of wool being put on at the time of the operation so as to act as an efficient splint and keep the parts at rest. When the wound communicates with the mouth drainage must be employed, and the tubes should be brought out at the most dependent spots, the tube being made to emerge in the posterior triangle through a button-hole in the skin.

Palliative treatment.—Something must be done to relieve the patient in inoperable cases, as death from cancer of the tongue is most painful. The fœtor of the breath, the intense pain, the frequent hæmorrhages and

the difficulty in swallowing and sometimes in breathing are sources of the greatest misery. *Dyspnœa*, if severe, of course necessitates tracheotomy. The *dysphagia* may in many cases be relieved by rectal feeding.[1] Enemata containing beef-tea, milk, the yolk of an egg, all previously peptonised, together with sufficient stimulant, should be given every four hours and in the intervals zyminised suppositories may be employed. When the pain on swallowing is so great it is seldom that an œsophageal tube can be passed with any comfort, and rectal feeding is the only alternative. Gastrostomy or œsophagostomy has been proposed, but the cases are hopeless and it is not worth while to prolong the patient's agony for a few weeks by such an operation.

To check the fœtor, the increased salivation and the hæmorrhage it has been proposed that, even when widespread glandular infection in the neck renders the case inoperable, it may be justifiable to try to remove the disease from the mouth so as to relieve the patient of these troubles. Of course if this be feasible and the patient can stand the operation, great benefit would no doubt result; at the same time however it is our experience that, when the disease can be removed from the mouth without much chance of recurrence, the glands may always be taken away, and the probability therefore is that in any case where the glands in the neck are really inoperable the disease in the mouth would be inoperable also, and thus the question would not arise. Unless the disease can be removed from the mouth with a good prospect of non-recurrence, this operation should of course not be done.

The fœtor of the breath should be treated by the frequent use of various antiseptic solutions as mouth-washes (sanitas or boro-glyceride), and by powdering the surface of the sore frequently with iodol and touching it occasionally with pure carbolic acid after drying it carefully. These means are as a rule however very ineffectual.

The *pain* is often much relieved by the insufflation of orthoform. The mouth is opened, the surface of the ulcer is cleansed and dried as far as possible, and the powdered drug is blown over the surface. Orthoform is not poisonous and there is therefore no danger in repeating this frequently. It should be applied at least half an hour before taking food as its effect often lasts for a considerable time and it may give great relief. Other drugs, such as cocaine and morphine, are of course also called for and these may be given as frequently and in as large doses as may be necessary, as the patient's life cannot possibly be a prolonged one.

The question often arises as to whether the lingual nerve should be divided in these cases to stop the pain. When it can be done, it is of course of great advantage, but, owing to the extent of the disease, this is generally impossible, and even when done it does not always relieve the patient's pain. The operation is done as follows:

[1] For the use of ox-serum in rectal feeding, as recommended by Dr. Otto Grünbaum, see footnote on p. 98.

Division of the lingual nerve.—The mouth is opened by a gag on the sound side, and the opposite angle is pulled back with a retractor. The tip of the tongue is then seized with forceps and pulled forcibly over to the sound side, when the nerve should start into prominence beneath the mucous membrane just behind and below the last lower molar. If a vertical incision be made through the mucous membrane in this situation the nerve can at once be identified, cleared and a portion excised. At the same time it is obvious that if the growth be situated in this region the operation is difficult or impossible. It has then been suggested to divide the nerve through an incision below the jaw and at the same time to ligature the lingual artery, but it is doubtful whether such a procedure is really worth while.

The *hæmorrhage* is often very trying and reduces the patient considerably, and it has been proposed to tie the external carotid in the neck, taking great care to keep the wound uninfected. It is a question whether it is not more merciful to allow the patient to die of the hæmorrhage. Styptics are of little use as they generally cause severe pain and do not materially check the bleeding. In some cases the hæmorrhage may be so severe as to kill the patient almost immediately.

Various substances such as methyl violet, Coley's fluid, etc., have been injected for the cure of inoperable cancer of the tongue, but, as far as our experience goes, we cannot recommend any of them.

CHAPTER V.

AFFECTIONS OF THE FLOOR OF THE MOUTH.

RANULA.

By a ranula is meant a cyst in the floor of the mouth or on the under surface of the tongue due to dilatation of one of the muciparous glands from blocking of its duct. In some cases the glands beneath the tip of the tongue may be the seat of the swelling and, when the tongue is put out, the tumour may be protruded instead of remaining stationary in the floor of the mouth in the usual position. The blocking of the duct may be due to an inflammatory condition about the orifice, or to obstruction by inspissated mucus.

The ranula is a rounded prominent swelling on one side of the middle line which varies in size from a pea to a plover's egg and has a characteristic bluish tint, which has been aptly compared to a purple grape. It contains a considerable quantity of mucin and may occasionally be large enough to interfere with the movements of the tongue.

Treatment.—*When the tumour is small*, the best plan is to paint the surface with a 10% solution of eucaine and to inject a few drops of the solution beneath the mucous membrane over the cyst and then, seizing its anterior wall in catch forceps, to divide the mucous membrane with a pair of sharp scissors and to remove the cyst entire. The wall of the cyst itself must be seized in the forceps and not merely the mucous membrane, or else the cyst wall cannot be properly pulled out.

When the cyst is large, its removal entire involves a very difficult dissection which leaves a putrefying cavity in the floor of the mouth. The best plan is to apply eucaine as above, to pull up the tongue with tongue forceps, to seize the anterior wall of the cyst in catch forceps and to clip away as much of it as possible so as to expose freely the deeper part of the cavity. This portion is then scraped with a small sharp spoon and sponged over with undiluted carbolic acid or still better with pure nitric acid on a glass brush; the acid is subsequently neutralised by filling the mouth with a solution of carbonate of soda. A strip of iodoform gauze is then packed into the cavity and renewed daily until the cyst wall is everywhere granu-

lating. This method generally effects a cure, and it is only when recurrence takes place after it that it is necessary to subject the patient to the more severe measures required for complete removal of the cyst. If this becomes necessary it should be done under a general anæsthetic, the cyst carefully dissected out and the cavity left after operation carefully packed with strips of gauze, after the raw surface has been thoroughly swabbed over with a solution of chloride of zinc (40 grs. to the oz.) to prevent putrefaction.

SALIVARY CALCULUS.

Calculi not infrequently occur in the duct of the submaxillary gland. They may be met with at any part of Wharton's duct but are commonest near its orifice. They are more or less spindle-shaped, and consist mainly of phosphate of lime with a little calcium carbonate deposited around a nucleus of inspissated mucus. At first the calculus passes unnoticed and the patient's attention is often only called to it by an enlargement of the submaxillary gland. This structure undergoes chronic inflammation from the obstruction to the outflow of the saliva, and becomes enlarged; the enlargement is increased on taking food and may cause much discomfort.

A calculus impacted near the orifice of the duct is easily detected as a hard, elongated mass in the line of the duct, the orifice of which is usually swollen and reddened. After the stone has remained in the duct for some time the tissues around become much thickened, and it is sometimes difficult to be certain that the case is not one of tumour, so that it may be necessary to incise the swelling or to introduce a needle into it to make sure. Suppuration not infrequently occurs behind or around the stone, and a ragged sinus discharging pus or even an extensive ulcer in the floor of the mouth may be left; through this opening the calculus may sometimes escape. When calculi occur actually in the gland they are by no means easy to diagnose, and as a rule the exact nature of the affection is not known until the gland is cut down upon.

Treatment.—The stone should be removed as soon as its presence is diagnosed. *If it be situated near the orifice of Wharton's duct*, the operation is extremely simple and no general anæsthetic is required. The mucous membrane is swabbed with a 10% solution of eucaine, a few drops are injected in the neighbourhood of the duct and a fine canaliculus director is passed through the orifice, when the stone is usually struck at once. Along the groove of the director a canaliculus or very fine tenotomy knife is introduced and the orifice of the duct slit up sufficiently for the stone to be extracted. The extraction is quite simple, the calculus often shooting out of its own accord as the incision is made. If not, a fine pair of sinus forceps will easily withdraw it. There is usually very little bleeding and there is no need to suture the opening in the duct. A mouth-wash of chlorate of potash (grs. xv. to the oz.) should be used for a few days.

When the calculus is far back along the duct, however, the operation may

be exceedingly difficult, especially if there be much inflammatory thickening of the tissues around. As the duct passes backwards to the submaxillary gland it lies deeper and deeper in the floor of the mouth, and it comes into close relation with the lingual gustatory nerve which lies on its outer side about the level of the anterior border of the hyoglossus muscle, so that any deviation from its direct line is likely to divide the nerve, and in several cases this has actually occurred, leading to a troublesome and persistent anæsthesia of one half of the tongue. It is best to operate under a general anæsthetic, as it is almost impossible to control the movement of the tongue if the patient be only under local anæsthesia and the operator has to work far back. The mouth is opened by a gag, the head is propped up in a good light, or a powerful reflector is employed, and the tongue is pulled forcibly over to the opposite side so as to make the structures in the floor of the mouth as tense and steady as possible. The calculus is then felt for and is steadied by the forefinger of the left hand pressing it outwards against the ramus of the jaw, whilst the surgeon cuts directly down upon it in the line of the duct and attempts to reach the stone at the first incision. The fixation by the finger should not be relaxed until the stone has actually been exposed, as otherwise the parts recede deeply into the floor of the mouth and a second incision may go in a different direction and do damage. When the stone is situated very far back, it is a useful plan to thrust a sharp hook through the mucous membrane of the floor of the mouth beneath the swelling and hook it forcibly upwards and so fix it while it is cut down upon. When the stone has been reached, the duct is slit up sufficiently to enable the stone to be withdrawn without any force. The calculus must be carefully examined after removal to see if any portions have been chipped off and left behind, and if so they must be searched for and removed, as they may otherwise become the nuclei of fresh calculi. The wound in the mouth needs no treatment beyond the use of a simple mouth-wash of chlorate of potash, used hot for a few days. There is generally some interference with the movements of the tongue as a result of the swelling following the operation, but this subsides quickly.

When the calculus is situated in the gland itself, an attempt to remove it from the mouth—unless it can be seized in a fine pair of forceps and withdrawn through the duct—will not only jeopardise the lingual nerve, but will be apt to give rise to dangerous cellulitis, as it necessitates a deep dissection in the floor of the mouth. Moreover, stricture of the duct is very likely to occur subsequently from cicatricial contraction. Under these circumstances it will be best to excise the gland and its duct completely by an external operation, as a mere incision for extraction of the stone would be likely to be followed by a salivary fistula. The operation has already been described (see p. 52).

DERMOID CYSTS.

Dermoids are not at all uncommon beneath the tongue and generally occur in the middle line either in the anterior third of the tongue itself or more deeply seated in the floor of the mouth, bulging below between the jaw and the hyoid bone and upwards beneath the mucous membrane. More rarely they occur far back along the raphe and occasionally are met with to one side somewhat below the angle of the jaw. These cysts are sometimes confounded with ranulæ, from which however they differ fundamentally. They are thick-walled, situated beneath the mucous membrane and do not present the purplish appearance characteristic of a ranula. If there be any alteration in colour it is a somewhat yellowish tinge from the contents showing through the wall. Whereas a ranula is situated immediately beneath the mucous membrane, dermoids are always deeper and project into the neck as well as into the mouth. They are usually situated between the genio-hyo-glossi muscles and above the mylo-hyoid.

Treatment.—The cyst always requires extirpation, any other treatment being followed by recurrence. Whenever it is possible, it is best to remove the cyst from the neck rather than from the floor of the mouth, although when quite small it may sometimes be removed from the latter situation. When removed through the neck, the wound is aseptic and heals at once, and the only disadvantage is that a slight scar is produced; this however need only be small, as the cyst is easily separated by the finger and, after having been isolated, can be opened and its contents squeezed out so as to enable it to be removed through a small opening. On the other hand, if removed from the mouth, a large cavity is left amongst the muscles, and extensive putrefaction and severe sepsis are most likely to occur; should this be done, it is well to make a counter-opening through the skin of the neck and introduce a drainage tube for the first week.

The cyst is best removed through a median incision between the chin and the hyoid bone, the muscles being separated in the middle line and the cyst wall exposed. As soon as the cyst is reached, its wall is easily separated from the surrounding structures by a blunt dissector or by introducing a finger through the wound and sweeping it around the cyst wall. It will usually be found quite easy to do this completely without opening into the mouth, even though the cyst extend right up to the mucous membrane, as there is generally no inflammatory adhesion between the two. When thus completely isolated, the cyst is turned out, either entire if it be small enough to be delivered through the opening, or an incision may be made into it and its contents squeezed out sufficiently to enable the whole cyst wall to be pulled through the opening. The wound is then brought together with a continuous suture and the usual dressings are employed. If the cyst be very large and burrow deeply amongst the muscles of the tongue, especially if it be situated in the lateral

region of the neck rather than in the middle line, a fine horsehair drain may be inserted for the first 48 hours to prevent accumulation of blood in the cavity from which the cyst has been removed.

LUDWIG'S ANGINA.

This is a streptococcal infection of the tissues in the floor of the mouth leading to acute cellulitis of the neck of a very dangerous character. The mischief usually arises from some small sore in the floor of the mouth or the tonsillar region through which the organisms gain entrance. It is most common among adults, but may also occur in young children, and is a particularly fatal and grave disease, as it is common to get gangrene of the tissues in the deeper planes of the neck.

In a very few hours after infection the floor of the mouth becomes hard and brawny, so that the tongue is raised and thrust upwards against the hard palate whilst the skin in the submental or submaxillary regions becomes indurated and dusky red in colour; articulation and mastication are both interfered with and there may be considerable dyspnœa, partly as the result of the swelling of the tissues in the neck, but mainly owing to the spread of the inflammation backwards giving rise to œdema of the glottis. The temperature is often high at first but falls later on, and the patient shows symptoms of profound septic poisoning, rapidly passing into the typhoid condition. In the majority of cases a fatal result occurs, often in about three days from the commencement.

Treatment.—The only chance in this disease is to adopt early and energetic treatment. In the earliest stages, before the disease is fully established in the cellular tissues of the neck, *antiseptic mouth-washes*, such as sanitas or 1-4000 corrosive sublimate, may be of service and should be employed as frequently and as hot as possible. *Large fomentations* (see Part I., p. 12) made with boracic lotion instead of hot water should also be applied to the submental and submaxillary regions and it is well to commence at once by injecting a large dose of *antistreptococcus serum*. These cases are always due to streptococcal infection and are very typical indeed in their symptoms, so that there is no need to lose time while waiting for bacterial cultivations to be made. The use of the serum should be at once resorted to and it must be remembered that if it does no good it does no harm. A full dose of 30 cc. of the present Jenner Institute serum is injected at once and doses of 10-15 cc. are repeated two or three times a day. The mistake generally made is to inject too small rather than too large a quantity.

Directly brawniness in the neck is evident, *free incisions* should be made everywhere through the affected part so as to facilitate the free escape of sloughs and pus. Nothing but the freest possible opening up of the affected area is of any use. The incisions should go through the deep fascia in several places and the tissues should be widely opened by the

finger and forceps so as to allow of the best possible drainage. The wound should be freely sponged over with undiluted carbolic acid, powdered with iodoform and stuffed with strips of iodoformed gauze.

When the disease commences far back in the mouth, it is generally unilateral and the treatment may be usually confined to one side of the neck. It must however be remembered that it often spreads from one side to the other and careful watch must therefore be kept on the other side and on the slightest sign of brawniness the tissues there must be opened up. When the tongue itself and the floor of the mouth are very markedly brawny they must be opened up also by free incisions (see p. 4). Care must be taken in the case of the floor of the mouth to avoid the lingual nerve and Wharton's duct (see p. 62). The incisions here should only go through the mucous membrane; the forceps are then used to open up the deeper tissues. Incisions in the mouth should not be made on account of the difficulty of drainage unless definitely called for. The general treatment of diffuse cellulitis (see Part I., p. 35) must accompany these procedures; quinine in large doses (gr. xv. three or four times a day) is most valuable.

In spite of the free incisions it is not uncommon to find that the obstruction to respiration is so great as to call for intubation or tracheotomy. Whenever it is possible, *intubation* (see Part V., p. 248) should be preferred, as a tracheotomy wound, especially when the neck has been laid open freely, almost unavoidably becomes infected, and septic pneumonia of a most grave type is very liable to set in. At the same time however intubation is not always feasible as the swelling may not be limited to the glottis but may occur actually in the larynx. Under these circumstances we ourselves should prefer to use a Hahn's or Trendelenburg's tube for the first 24 or 48 hours so as to prevent as far as possible the introduction of septic material into the air passages beside the tube.

DIVISION II

THE SURGICAL AFFECTIONS OF THE PHARYNX, ŒSOPHAGUS AND NECK.

CHAPTER VI.

AFFECTIONS OF THE PHARYNX AND TONSILS.

CONGENITAL MALFORMATIONS OF THE PHARYNX.

The only two that need reference here are pharyngeal fistula and pharyngocele.

PHARYNGEAL FISTULA.—This is a very rare condition, resulting from the incomplete closure of one of the branchial clefts. The condition will be however better dealt with in connection with affections of the neck (see Chap. VIII.).

PHARYNGOCELE.—This is the term applied to a pouching of the pharynx, the congenital nature of which is doubtful. The pouch usually occurs at the lower part of the pharynx on its posterior aspect, and, as it increases in size, generally passes towards the left side. The wall of the pouch usually possesses muscular fibres, and food collects in the interior causing a swelling of the neck which may be emptied on pressure. From time to time the retained food may be vomited in a more or less decomposed condition and, when the pouch is large and full, it may actually interfere with swallowing by pressure on the outside of the pharynx or œsophagus. It is a very rare condition and usually occurs in males.

When the orifice of communication between the pouch and the pharynx is very small, food may not pass into the diverticulum, which may then become distended with air and form a resonant swelling in the neck easily emptied by pressure.

Treatment.—The only effectual treatment is to *excise the pouch* and suture its connection with the pharynx. The patient is anæsthetised, a

bougie is passed through the orifice of the pouch so as to define it, and the anterior triangle is opened up by an incision along the anterior border of the sterno-mastoid. The vessels are defined and pushed backwards, the larynx is pulled well inwards and the pouch is thus exposed in the interval and its boundaries thoroughly defined; this is facilitated by the presence of the bougie passed into it. The entire sac wall is then removed up to its origin from the pharynx and the incision in the latter is accurately sutured with catgut stitches inserted Lembert-fashion (see p. 89) through the muscular wall. A drainage tube is inserted well up to the neighbourhood of the pharyngeal incision in case the latter should give way, and the skin incision is sutured.

After-treatment.—The patient should be fed by the rectum for three or four days, so as to avoid all chance of endangering the line of union in the pharynx. Should the latter give way, as will be shown by saliva escaping through the drainage tube, the patient should be instructed to gargle frequently with boracic lotion and to swallow small quantities of it, with the object of keeping the pharyngeal wall as clean as possible and of allowing a certain amount of boracic lotion to find its way down through the drainage tube and to keep the wound as aseptic as possible.

INJURIES OF THE TONSILS AND PHARYNX.

These are not at all common. Foreign bodies, such as a pipe-stem, may be driven deeply into the substance of the tonsil or the pharynx and cause a *lacerated* wound, or some of the vessels around the pharynx may even be torn and dangerous hæmorrhage may occur. Bleeding of this kind usually comes from the tonsillar circle of vessels, which is composed of the anastomosing branches of the following vessels—the dorsalis linguæ branch of the lingual artery, the ascending palatine and tonsillar branches of the facial, the ascending pharyngeal branch of the external carotid, and the descending palatine branch of the internal maxillary.

Treatment.—The most important point is to get the patient in a good light and to open the mouth well with a suitable gag. If good daylight be not available, a forehead mirror or an artificial light should be employed. The blood is then mopped up with small sponges upon sponge-holders or forceps, and any spurting vessel seized with a pair of Liston's fenestrated artery forceps and tied. If the hæmorrhage be merely a severe oozing, the best plan is to push a small plug of wool dipped in supra-renal extract well into the wound and to hold it there for a short time, when the bleeding, unless it be very severe, will usually cease. In the more serious cases of oozing it may be necessary to hold a sponge firmly pressed against the vessel whilst counter-pressure is made by the finger just behind the angle of the jaw externally. The sponge should be impregnated with a solution of supra-renal extract, tannin or matico, and it may be necessary to keep up the pressure for some hours.

In the very severe cases, where the hæmorrhage comes from a deep wound of the tonsil, it has been necessary to tie the main vessels before the bleeding could be stopped. If this should be called for, the bifurcation of the carotid should be exposed in the neck and the external carotid trunk tied close to its origin so as to include the ascending pharyngeal branch (see Part II., p. 320). Before tying the ligature it should be simply tightened so as to temporarily obstruct the vessel and see if the bleeding is arrested. Should this not be the case the hæmorrhage is probably from some wound of the internal carotid, which should then be ligatured. When however the case is one of hæmorrhage from a wound of the internal carotid trunk, the patient usually bleeds to death before help can be obtained. Should the case be seen in time, temporary digital compression of the bleeding point by the finger in the mouth pressing outwards against another pressed well in behind the angle of the jaw should be employed until the patient can be operated upon.

FOREIGN BODIES IN THE TONSILS AND PHARYNX.

Besides being met with in the pharynx, foreign bodies may occasionally be found in the tonsils, but these do not require much description. They are chiefly small bits of bone, fish-bones, etc., which can easily be seen on examining the throat in a good light, and can be removed with forceps.

The foreign bodies in the pharynx are of various kinds. They are generally bodies which are too large to pass into the œsophagus or which are sharp or jagged, and they often give rise to very severe symptoms from their presence in the neighbourhood of the aperture of the larynx. The chief of these are boluses of meat, tooth-plates, pieces of bone, etc.

Symptoms.—The symptoms vary according to the size and nature of the object. If it be large—such as a bolus of food—the upper aperture of the larynx is blocked, and the patient suffers from grave asphyxia and will die unless relieved immediately. In cases of smaller bodies such as fish-bones there is constant pain on swallowing, usually referred to a definite spot, and the constant irritation of the foreign body leads to the desire to cough and hawk up mucus. With the laryngoscopic mirror the body can often be seen.

Treatment.—*When the foreign body is large, and asphyxial symptoms are urgent*, a gag of some sort, a piece of wood or the handle of a knife, etc., should be introduced between the teeth, the finger thrust rapidly to the back of the pharynx, the foreign body felt for, the finger hooked round it and the object removed. This will always be successful when the obstruction is caused by a firm, smooth substance such as a mass of food. When, however, the body is angular and becomes impacted, as will be the case with a tooth-plate, the finger alone is not sufficient. A further attempt may be made to remove the body with suitable pharyngeal forceps (see Fig. 19) if they should happen to be at hand, but in many

cases the asphyxial symptoms will be so severe that the air-passages must be opened immediately and the removal of the foreign body postponed until normal respiration has become established. As soon as the trachea has been opened, a further attempt should be made to dislodge the foreign body. We have in one instance seen voluntary respiration delayed until the removal of the foreign body, in spite of previous opening of the trachea, and therefore one must not be satisfied with doing a laryngotomy, nor must one conclude that, because spontaneous respiration does not occur when the air-passages are opened, the patient's condition is hopeless. In a young child, inversion and vigorous shaking may be effectual in dislodging the foreign body.

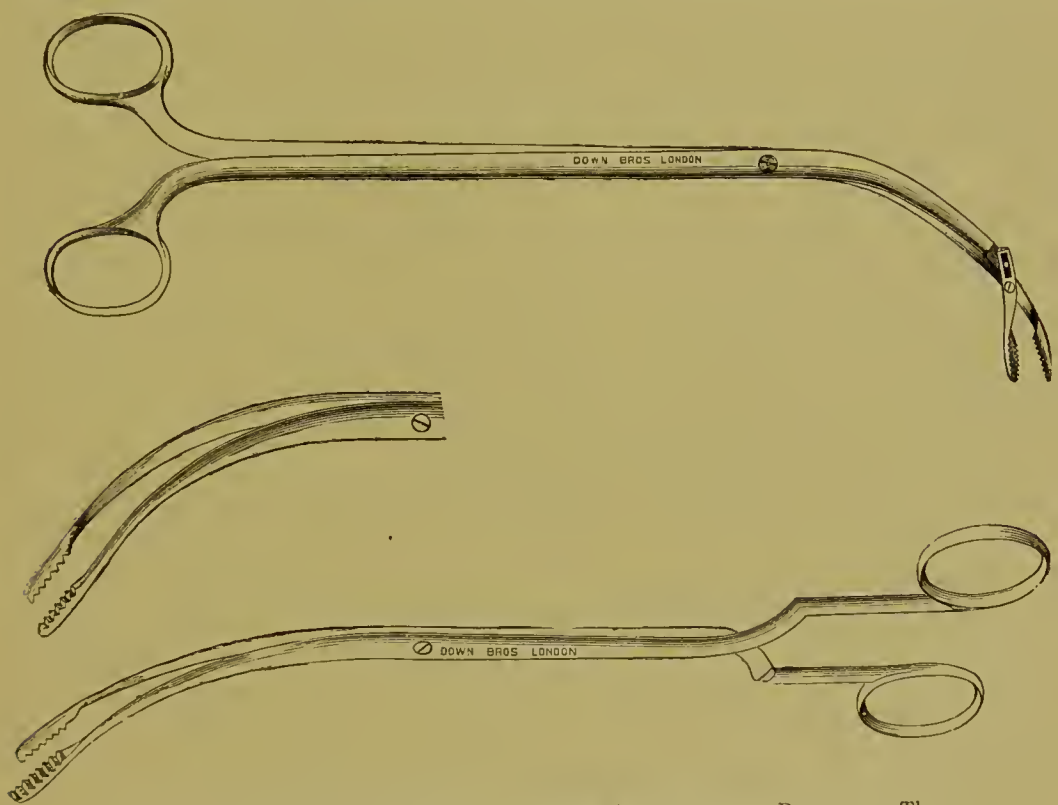


FIG. 19.—FORCEPS FOR REMOVAL OF FOREIGN BODIES IN THE PHARYNX. The blades of the lower pair are flexible and can be bent to any desired curve.

In order to remove foreign bodies from the pharynx, forceps with all sorts of curves must be at hand (see Fig. 19), the most useful being those bent at a right angle with blades opening in the antero-posterior direction. All attempts should be made under eucaine with a brilliant illumination. It may be necessary to break up the foreign body, especially when it is a tooth-plate, with cutting forceps and remove it piecemeal. Care must be taken in doing this to see that none of the pieces find their way into the larynx or down the œsophagus; they should be grasped in forceps before they are detached.

Pharyngotomy.—In some few instances the impaction may be so firm and the difficulty of getting at the object so great that pharyngotomy is

necessary. The operation is done much in the same way as that for the removal of a pharyngocele (see p. 67). The anterior triangle is opened in the usual manner and the vessels are freed and pulled out of the way. Whether they are pulled backwards or forwards will depend upon the position of the foreign body. In most cases they are pulled backwards and in that case it will be well to divide the thyroid, lingual and facial veins. Care must be taken not to injure the superior laryngeal nerve and it is well to introduce a bougie into the pharynx so as to make the foreign body more prominent and to serve as a guide. The pharynx is opened by a clean cut of sufficient size to enable the foreign body to be reached and extracted without difficulty. Should the body be very irregular and possess sharp hooks, these may be cut off with cutting pliers before removal. In all cases it is essential to do no damage to the pharyngeal wall by rough handling. The method of suture of the pharynx and the after-treatment are the same as that for the removal of a pharyngocele (see p. 67).

INFLAMMATORY AFFECTIONS OF THE TONSILS AND PHARYNX.

Inflammatory conditions of the tonsils may be considered under the headings of catarrhal and follicular tonsillitis, tonsillar abscess, hospital sore-throat, erysipelas of the tonsil, etc. They tend to spread from the tonsil on to the neighbouring pharyngeal wall.

ACUTE CATARRHAL TONSILLITIS is simply a catarrhal inflammation of the tonsil, usually ascribed to cold. It commonly passes off in a few days.

Treatment.—Little requires to be done. A purge should be given, the patient confined to bed or to a warm room, the throat wrapped up in hot flannel, whilst hot gargles of sanitas or Condy's fluid are employed. Some of these cases are looked upon as rheumatic, and the administration of ten-grain doses of salicylate of soda three times a day will often relieve the symptoms considerably in those who are susceptible to rheumatism.

FOLLICULAR TONSILLITIS.—This is an affection mainly of the crypts or follicles of the tonsil, probably bacterial in origin. It is commonly ascribed to bad hygienic conditions, such as defective drains, dirty bedding or direct infection by the discharges from the throats, etc., of those suffering from a similar affection. It is particularly liable to occur in those who are the subject of chronically enlarged tonsils.

Symptoms.—The disease is characterised by acute symptoms such as headache, pyrexia, etc., and is marked by the presence of small whitish-grey spots upon the tonsils, generally on both sides; these are at first multiple but may coalesce and form a sort of membrane which somewhat resembles the membrane in diphtheria but differs from it in being easily detached with a camel's hair brush. The diphtheritic membrane is very adherent and usually occurs in a single large patch, whereas the patches in follicular

tonsillitis are usually small and scattered over the tonsil. There is usually much painful swelling of the glands behind the angle of the jaw.

Prognosis.—As a rule these attacks pass off quickly. Although the temperature may be high and the swelling of the glands very marked and very painful, the acuter symptoms usually subside in four or five days and the glands very rarely suppurate. It must however always be remembered that the mischief is extremely liable to recur if the patient be constantly exposed to sources of infection such as those resulting from defective hygienic conditions. Another important point to bear in mind is that if the patient be the subject of chronically enlarged tonsils he is *ipso facto* predisposed to recurrence of these attacks and therefore the enlarged tonsils should be treated after the attack has subsided (see p. 75). Moreover the enlargement of the glands in the neck should be carefully attended to, as, unless the inflammation in them is made to disappear by suitable treatment, they are very liable to become the seat of tuberculous infection.

Treatment.—It is very important in the first instance to try to ascertain the cause of the mischief and to *remove the patient from any insanitary surroundings.* Thus, if the drains be defective, the patient should be removed from their influence or the defect immediately remedied. The possibility of infection from dirty rooms, dirty mattresses, pillows, etc., should be remembered and proper precautions taken against them. At the same time it is of extreme importance to point out to the patient the distinctly infectious nature of the disease, so that at any rate a certain amount of *isolation* may be practised. The other members of the household, especially children, should be kept away from the patient, and all possibility of direct infection by kissing, by using the same eating or drinking vessels, linen, etc., should be most carefully guarded against.

In the treatment of the disease itself *a purge* such as calomel (gr. v.), or mist. alb. (℥ iss.), should be given when the case is first seen and *large hot fomentations* (see Part I., p. 12) should be appplied around the throat and renewed every two or three hours. This relieves the stiffness and pain in the neck very considerably. In the ordinary cases the frequent employment of *antiseptic gargles* of weak sanitas or Condy's fluid, used as hot as the patient can bear them, is very comforting and relieves the pain on swallowing. In addition to this frequent gargling, *astringent and antiseptic applications* should be made directly to the affected area, and this is best done by painting on equal parts of liquor ferri perchlor. and glycerine with a large camel's hair brush; if this prove too irritating the proportion of the two may be altered. This application should be made about every four hours. If the stiffness of the throat and pain on swallowing be very annoying to the patient, lozenges containing chlorate of potash may be sucked in the intervals between the gargling.

In children, in whom the fever is often considerable, liquor ammoniæ acetatis (in doses of 2-6 drachms every four hours) may be given until the temperature subsides. In most cases the pain which is provoked by the

involuntary swallowing of saliva, mucus, etc., is so considerable that it tends to prevent the patient from sleeping, and a dose of *opium*, which is best given in the form of Dover's powder, will be necessary for the first night or two. The patient should always lie upon the side, so as to allow the saliva to run out of the mouth rather than down the throat. When the glands are very tender any movement of the neck gives rise to pain, and it may be necessary therefore to fix the head between sandbags or, in the case of children, in a large mass of cotton wool so as to restrain the movements.

When the affection is more acute than this, the iron and glycerine application is as a rule too irritating, and glycerinum acidi tannici similarly applied may be substituted for it. Under these circumstances too a particularly soothing and efficacious antiseptic application is a spray containing carbolic acid and tincture of iodine,[1] used in a Siegel spray apparatus for five minutes every two or three hours. This, however, should only be used with great caution in young children on account of the risk of the absorption of carbolic acid.

After the patches of exudation separate, small ulcers are left upon the tonsil which usually heal quite readily. If there be any delay, a very useful plan is to brush them over with a solution of nitrate of silver (grs. xx.-xl. to the oz.) every morning. After an attack of follicular tonsillitis the patient is generally considerably pulled down in health, especially if the attack has been a severe one, and hence during convalescence it will be necessary to order plenty of light nourishing food, port wine, etc., to provide if possible a change of air and to administer tonics internally. As soon as he has recovered the tonsils if still enlarged should be removed.

SUPPURATIVE TONSILLITIS.—This condition, popularly known as "quinsy," is an acute inflammation of the tonsil with suppuration around it. The pus usually forms outside the capsule of the tonsil and as a rule there is an acute tonsillitis on both sides whilst the suppuration occurs on one side only or, if bilateral, in one tonsil before the other. The temperature is very high, the tonsil is enormously enlarged so that it almost blocks up the aperture of the fauces, the glands behind the jaw are large, painful and may suppurate. There is considerable swelling of the neighbouring portion of the pharynx and sometimes also œdema of the glottis. The symptoms on the whole are very similar to those of other forms of inflammation of the tonsils, only much more severe. The pain, especially on any attempt to swallow, is very intense indeed.

Treatment.—Abortive treatment usually fails to prevent suppuration but may considerably relieve the patient. It is well to begin with *a saline purge* (mist. alb. ℥iss.) and to administer *tincture of aconite* in minim doses repeated every hour for four or five doses until the pulse rate approaches the normal,

[1] ℞ Acidi Carbol. ℥ ii.
Lin. Iodi ℥ i.
Spirit. vini rect. ℥ ii.
Aquam ad ℥ xii. Instead of the lin. iodi, the tincture (℥ ss) may be used.

and then to administer ten-grain doses of *salicylate of soda* every four hours. At the same time *large hot fomentations* changed every two or three hours should be applied to the neck to relieve the pain, while *steam inhalations* are employed for the relief of the pain on swallowing. Gargles are as a rule out of the question on account of the severe pain, but a spray of carbonate of soda in a Siegel's apparatus is extremely valuable, if there be an unduly free secretion of tenacious mucus which interferes largely with the patient's comfort. When this secretion is not excessive, the carbolic acid and iodine spray (*vide supra*) is very valuable as, apart from its antiseptic action, the carbolic acid is a useful sedative.

Suppuration usually occurs about the third day, and watch should be kept for its occurrence. When pus forms above the tonsil the soft palate becomes very œdematous and swollen. Usually, however, the pus makes its way forward through the substance of the tonsil itself; sometimes suppuration occurs below it. These tonsillar abscesses should always be opened.

When the suppuration is situated above the tonsil the surgeon will be guided as to the right time to open the abscess by the amount of swelling and œdema of the soft palate. When this has lasted for three or four days or is steadily increasing, the presence of pus may be fairly safely assumed and, even should a mistake be made, the incision will act usefully in draining the congested parts. Local anæsthesia is all that is necessary, a 10 °/₀ solution of eucaine being swabbed over the proposed seat of incision with a small pledget of wool on forceps; this is a better plan than employing a spray, as the patient does not swallow the drug. An incision is made through the mucous membrane of the soft palate just external to and parallel with the anterior pillar of the fauces rather above the centre of the tonsil. The knife should be a tenotome or the kind used for paring the edges of a cleft palate; a narrow-bladed bistoury guarded up to within half an inch of its point by wrapping it in strapping to avoid injuring the tongue may be used when neither of these is at hand. The blade should be introduced flatwise and then turned with its cutting edge downwards when it reaches the soft palate. There is no need to make the incision deeper than the mucous membrane, and the operation may be completed by pushing a pair of sinus forceps into the soft palate in a line parallel to the last molar teeth, taking great care to avoid pushing the points outwards into the neck. When the abscess is hit, pus appears, and the blades are separated widely so as to insure the free escape of the pus without any need for subsequent drainage, and the head should be depressed so as to allow the pus to run out of the mouth and not down into the throat. The mouth should be washed out immediately afterwards with boric lotion. It is always well to attempt to open these abscesses, for even if the incision fails to hit the abscess cavity, the pus will probably find its way through it in the course of a few hours.

When the abscess is situated in the substance of the tonsil it may be incised by a bistoury (*vide supra*) thrust into it in a line with the last molar teeth.

If the knife does not strike the abscess at once the incision should be enlarged by pushing sinus forceps into it. When the pus is reached it is evacuated by forcibly opening up the abscess cavity with the forceps.

When the abscess is situated very far down, it may be necessary to allow it to burst spontaneously, as it may not be possible to reach it comfortably through the mouth; but it is always good practice to attempt to open it even here as, though the incision may fail to hit the abscess, the local depletion is good, and a track will be opened up through which the pus may find its way out earlier than it otherwise would.

After-treatment.—These cases usually recover very rapidly when once the abscess is opened and little in the way of after-treatment is required. For the first day or two it is well to continue with an antiseptic spray, of which the carbolic and iodine (see p. 72) is perhaps the best. As soon as the swelling has subsided a little, the patient will be able to use an antiseptic gargle containing sanitas or chlorate of potash. The same treatment with regard to the administration of tonics, food, fresh air, etc., is applicable to this stage as to follicular tonsillitis (see p. 71).

HOSPITAL SORE-THROAT.—This is an inflammatory condition of the tonsil frequently accompanied by sloughing and followed by ulceration of a somewhat rebellious type. It is common amongst those who work in hospitals and hence its name. The affection is often somewhat difficult to diagnose from diphtheria as it may be accompanied by most of the symptoms except the presence of an adherent membrane

Treatment.—This should be on the lines laid down for follicular tonsillitis (see p. 71); special importance attaches to the application of astringents and antiseptics to the lesion in the throat. Equal parts of liq. ferri perchlor. and glycerine may be painted on three or four times a day, whilst a solution of nitrate of silver (gr. xx.-xl. to the oz.) may with advantage be brushed over every morning. The disease is of an infective nature and is the form specially liable to be followed by Ludwig's angina if neglected. It is of primary importance in the treatment to remove the patient from the surroundings in which he has contracted the affection, as otherwise remedial measures are used in vain. Hygiene, nourishing food and the administration of port wine, are very important; a short holiday in the country is of the greatest advantage.

The tonsillar inflammation accompanying diphtheria does not need description here.

ERYSIPELAS OF THE TONSIL.—In some cases erysipelas may occur primarily in the tonsil although it is usually secondary to the same condition upon the face. When the disease occurs primarily, the diagnosis from ordinary catarrhal tonsillitis is extremely difficult. Generally in erysipelas the constitutional symptoms are more severe. There may be rigors, sickness and a very high temperature with delirium, whilst the diagnosis is usually cleared up by the spread of the erysipelas to the face after two or three days.

Treatment.—There can be little treatment specially directed to erysipelas of the tonsil. The *general treatment* for erysipelas (see Part I., p. 218) should of course be adopted and the patient should be isolated. Little is possible in the way of *local treatment* beyond the application of large hot fomentations to the neck to relieve the pain, and the employment of antiseptic gargles if the patient can use them. The carbolic and iodine spray (see p. 72) every two or three hours is very useful, either in conjunction with an antiseptic gargle or alone, if the patient be unable to use the latter.

CHRONIC ENLARGEMENT OF THE TONSILS.—This is a common affection and generally arises from some constitutional disease or repeated slight catarrhal inflammations. It may also follow repeated attacks of acute tonsillitis. It is practically invariably associated with the presence of adenoid vegetations in the naso-pharynx and many of the symptoms attributed to the tonsillar affection are really due to the presence of adenoids. The affection is one of great importance because the enlarged follicles of the tonsil serve as a means of arresting all kinds of organisms and hence the patient is constantly liable to acute attacks of follicular tonsillitis and also to tuberculous glands in the neck. Moreover the affection greatly hinders proper respiration and so interferes with nutrition in general.

Treatment. (a) Palliative.—When the enlargement of the tonsils is not very marked and the patient is strongly disinclined to have them removed, palliative measures, such as painting the tonsils with equal parts of glycerine and liq. ferri perchlor, with glycerinum iodi or glycerinum acidi tannici may be employed, together with the administration of cod-liver oil and iron. Good hygienic conditions and good food are also essential.

(b) Operative.—When the enlargement is at all marked and symptoms of imperfect respiration, such as thick speech, nasal voice, snoring at night, etc., are associated with it or when the patient is subject to repeated attacks of "sore throat," removal, not only of the tonsils but of the adenoids, is strongly to be advised. The operation for the adenoids has already been described (see Part V., p. 262).

Tonsillotomy is a comparatively simple operation and may be performed if necessary without an anæsthetic, but, as the enlargement of the tonsils coincides in the majority of cases with the presence of adenoid vegetations, it is well to insist on an anæsthetic so that both conditions may be remedied simultaneously. The question as to whether the adenoids should be removed before the tonsils or *vice versâ* has been a good deal debated. A good many surgeons prefer to remove the adenoids first, as being the most important and as freeing the operator from any anxiety about possible hæmorrhage from the tonsils while he is doing the adenoid operation. On the other hand, better access is probably obtained to the naso-pharynx if the tonsils, especially when markedly enlarged, be removed first. The

bleeding is after all a matter of slight importance, especially if the child's head be kept low.

Tonsillotomy.—*By the guillotine.*—The best method of removing the tonsils is with a guillotine, preferably Mackenzie's (see Fig. 20). The ring into which the tonsil is received is variously shaped, being sometimes circular for tonsils that are not unduly elongated in any particular direction, and sometimes oval, with its long axis either horizontal or vertical, so as to be applicable to tonsils that are especially elongated in either direction. Unless the patient be a young child no assistance is required, but in the young it is necessary to have someone to keep the mouth open with a gag and also to

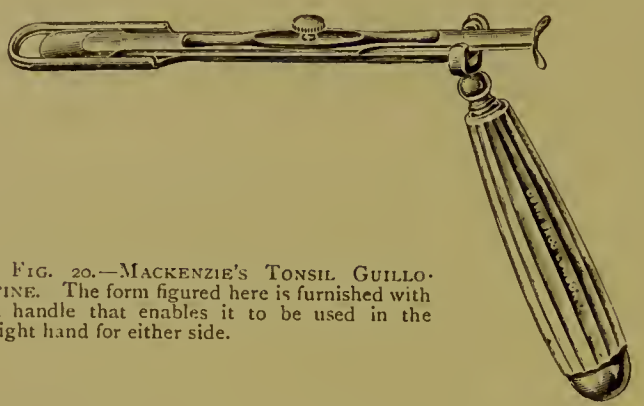


FIG. 20.—MACKENZIE'S TONSIL GUILLOTINE. The form figured here is furnished with a handle that enables it to be used in the right hand for either side.

make counter-pressure over the tonsil and to hold the head. All this, of course, can be done by the anæsthetist when an anæsthetic is being employed. The tonsillotome is introduced with its flat surface parallel to the dorsum of the tongue until it reaches the back of the pharynx, when it is turned so that the tonsil is received into the ring of the instrument. If the operation is being done without an anæsthetic, care should be taken to avoid touching the tongue as the instrument is passed in, and the parts should be thoroughly anæsthetised by spraying with a 10 per cent. solution of eucaine. As the tonsil is received into the ring of the instrument, the assistant presses firmly inwards beneath the angle of the jaw so as to steady the tonsil and press it well into the loop. The surgeon then manipulates the instrument so as to press its end firmly outwards against the pharyngeal wall, and sharply pushes the cutting blade home with the thumb. This movement, although momentary, requires care to avoid tilting or rotating the instrument as the blade is pushed home. Unless the tonsillotome be held absolutely steady, its end is deflected inwards and a portion of the tonsil will escape. If the operation be done under an anæsthetic, the whole procedure can be carried out by the sense of touch rather than by sight, the forefinger of the other hand being introduced into the mouth to see that the ring of the instrument is properly in position. When no general anæsthetic is being used a good light, either natural or artificial, is essential.

The patient's left tonsil is quite easily removed in this manner, and if the surgeon be ambidextrous an exactly similar proceeding can be carried out

upon the right side. Unless this be the case, however, the surgeon must either have an instrument with an interchangeable handle so as to enable him to remove the right tonsil with the right hand, or he must stand somewhat behind and to the side of the patient and introduce the tonsillotome from that position. If he employs this position he can push the tonsil into the ring of the guillotine by making counter-pressure with the thumb of the left hand. Removal of the two tonsils should be done as rapidly as possible; no attempt should be made to stop the bleeding from the first before attacking the second. If done sufficiently quickly, the second tonsil can be removed before any considerable bleeding has had time to occur from the first, and attempts to check the bleeding before proceeding to the second operation merely serve to obscure the view and to give the patient's courage time to evaporate.

By the bistoury.—The older plan, which still has to be adopted when no tonsillotome is at hand or when the tonsil is too flat to be seized in the instrument, is to grasp the organ with a pair of vulsellum forceps (see Fig. 21) by which it is pulled a little towards the middle line and held steady

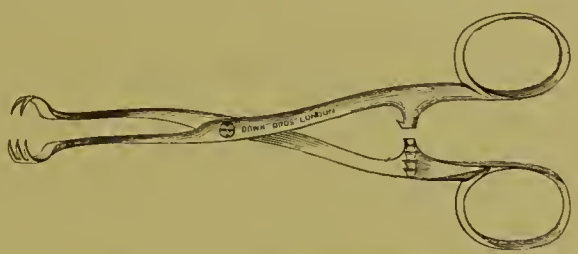


FIG. 21.—VULSELLUM FORCEPS. The instrument takes a firm hold of the tonsil and does not tear out.

while the projecting portion is sliced off with a probe-pointed knife (an ordinary herniotome is a very good one). The knife should be introduced with its blade parallel to the line of the molar teeth and should cut vertically downwards. It must not be inclined outwards as otherwise vessels may be injured; neither must the tonsil be dragged too violently towards the middle line or the same accident may happen. The object of the vulsellum forceps is more to fix the tonsil than to pull it inwards. If an ordinary probe-pointed knife be used, its blade should be wrapped round with strapping so as to leave only about an inch exposed in order to avoid damage to the tongue which should be depressed by a suitable depressor.

Hæmorrhage after tonsillotomy is rarely severe and usually stops readily on sucking ice or on the application of temporary sponge pressure. Should the bleeding be so severe as to demand something more, the surface may be painted over with supra-renal extract in really serious cases or with some styptic such as tincture of matico or liquor ferri perchlor. (for methods of using styptics, see p. 67). A few cases have occurred where the bleeding has been arterial and profuse and in a few it has proved fatal. In all cases of bad bleeding the mouth should be opened widely by a gag in a bright light, any spurting vessel looked for and, if seen, caught and tied.

Failing this, the tonsil must be firmly compressed between a sponge on a sponge-holder, which is dipped in a suitable styptic (*vide supra*), and a finger pressed in over the tonsil externally. This compresses the remains of the tonsil firmly and the pressure should be kept up for half an hour or so, when the styptic will have had time to act and the hæmorrhage will usually cease. Bleeding of such a profuse character as to necessitate the ligature of the main arterial trunks will hardly ever be met with, but, should the method recommended above fail, it might possibly be necessary to compress the common carotid artery temporarily whilst the external trunk is exposed and tied. Injury to the internal carotid artery has been described as the result of this operation, but it is practically impossible for it to occur when a tonsillotome is used, and it is hardly likely to happen even when the older method is employed.

After-treatment.—This is quite simple. The patient should be kept indoors for a day or two and confined to his room so as to avoid cold. Before performing an operation such as tonsillotomy, the hygienic conditions of the house should be inquired into, as if the operation be done in a house where the drains are defective, serious septic sore-throat is apt to follow. As a local application some mild antiseptic gargle, such as chlorate of potash and boracic lotion, is all that is required. Soft food should be given for the first four or five days.

Results.—In the operations for the removal of enlarged tonsils only a portion, and in many cases not a very large one, is removed. If a slice of the surface be taken away it is usually found that atrophy of the greater part of the remainder occurs. It is however necessary to remove all the crypts on the surface because it is probably in connection with them that the irritation occurs which leads to the enlargement. It must however be admitted that sometimes, even when the tonsil has been removed as described above, recurrence takes place and further operation is necessary. In these cases it may be feasible to shell out the entire tonsil, which is readily done by administering a general anæsthetic, opening the mouth with a gag in a good light and carrying an incision through the mucous membrane just behind the anterior pillar of the fauces; the finger is then introduced through this incision and the tonsil shelled out. However a procedure of this kind is not to be recommended as a general method of treatment as we do not know the function of the tonsil and recurrence occurs only in a few cases.

CALCULI OF THE TONSILS.—Collections of mucus and calcareous material may occur in the crypts of the tonsils and may occasionally give rise to actual calculi. They cause few symptoms and are easily recognised as whitish projections from the surface of the tonsil.

Treatment.—The tonsillar crypt can easily be cleared out with a sharp spoon of convenient size. Should there be any difficulty in doing this or should the collections be numerous, it is simplest to shave off the surface of the tonsil with a tonsillotome (see p. 76).

ACUTE RETRO-PHARYNGEAL ABSCESS.—The only acute inflammatory affection of the pharynx which needs a separate description is suppuration following an acute pharyngitis, which sometimes occurs in children.

Difficulty in swallowing is early marked, accompanied by considerable pain, and examination shows that this difficulty is caused, not by a diffuse inflammatory condition of the mucous membrane, but by a localised swelling. The prominence usually occurs in the pharyngeal cavity; very rarely swelling is evident in the anterior triangle. The condition is serious as the pus may burrow in various directions and when of any size the abscess interferes considerably both with deglutition and respiration. If left alone it bursts spontaneously into the throat and there is some danger that the patient may be asphyxiated if this occurs during sleep.

Treatment.—The abscess should be evacuated as soon as possible, preferably from the neck. This is quite easily done and the cavity heals just as rapidly as does that of any other acute abscess, and therefore we should always advise this being done except possibly in cases where asphyxia is imminent.

By external incision.—An incision is made just behind the posterior border of the sterno-mastoid, commencing above at the mastoid process and running downwards for about an inch and a half. The incision is deepened until the deep fascia is opened behind the muscle, the posterior border of which is hooked up with a retractor while the finger introduced into the wound feels for the transverse processes of the cervical vertebræ. A blunt dissector is then gradually insinuated behind the vessels until the abscess cavity is reached; this is facilitated by keeping one finger upon the abscess in the mouth so as to ascertain the right direction in which to work. If the instrument be kept along the anterior surface of the transverse processes and made to bore directly into the abscess cavity, no difficulty at all is encountered and the abscess can be opened in a few seconds. The channel is enlarged by introducing a pair of dressing forceps along the dissector and carefully expanding the blades in the vertical direction. The finger may then be insinuated into the abscess cavity and a drainage tube inserted. Care must be taken that the end of this does not impinge upon the pharyngeal wall, as otherwise ulceration of the mucous membrane may occur over it and a fistulous communication be established. The subsequent treatment is the same as that for any other acute abscess; the tube may usually be left out in four or five days, healing occurring in a week to ten days.

The abscess should never be opened through the anterior triangle as is sometimes recommended. It will be found extremely difficult to reach the abscess cavity by this route as the vessels have to be carefully defined and pushed out of the way and very considerable bleeding and a tedious operation may result. Moreover the drainage tube inserted into the abscess cavity is very apt either to press injuriously upon the vessels or to become kinked when the structures are allowed to fall back into position.

By incision through the mouth.—When asphyxia is absolutely imminent in a case of acute retro-pharyngeal abscess, it may not be feasible to give an anæsthetic and to spend the few extra minutes that are necessary for the external operation. Under these circumstances the child should be firmly pinioned in a blanket or jack-towel and held almost inverted, or at any rate with the head very low, while a suitable gag such as Doyen's (see Fig. 22) is introduced, the forefinger of the left hand passed well back over the dorsum of the tongue, which is depressed and hooked forward out of the way, and a cleft palate knife, or a guarded bistoury (see p. 73) is plunged into the abscess cavity in the middle line so as to open it freely. The escape of the pus from the mouth is facilitated by inverting the child and turning the mouth towards the floor; pus can then hardly find its way into the air-passages.

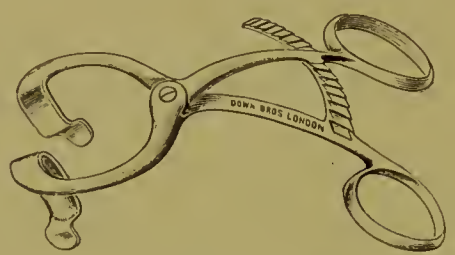


FIG. 22.—DOYEN'S GAG. A very useful form of instrument, especially when working without anæsthesia, or when the latter is incomplete. The arms of the gag are so made that the teeth cannot escape from them when the gag is fully opened. They take purchase on the front teeth.

After the operation all the treatment necessary is to give soft food and either make the patient gargle freely with sanitas or Condy's fluid or have the back of the throat sprayed or swabbed out frequently with the same applications according to the patient's age.

CHRONIC—TUBERCULOUS—RETRO-PHARYNGEAL ABSCESS.—Chronic tuberculous abscesses also occur at the back and sides of the pharynx and are usually the result of tuberculous disease of the cervical vertebræ. Sometimes however they may be due to suppuration in tuberculous post-pharyngeal glands. The abscess pushes forwards the posterior pharyngeal wall and narrows the faucial orifice and may be large enough to interfere with the breathing. If left alone, it extends also laterally into the neck, but before long it usually bursts into the pharynx, giving rise to a septic tuberculous sinus which will not heal. This is especially the case when the abscess depends upon disease of the spine; a painful foul ulcer is then formed on the posterior pharyngeal wall with a pouch behind it in which septic material collects and the patient goes steadily downhill.

Treatment.—If the abscess be opened in the manner just described (see p. 79) the contents washed out and iodoform emulsion injected, it does as well as a chronic abscess elsewhere. Moreover by this method it is also often possible to get at the tuberculous focus in the spine and to treat the bone disease appropriately, removing sequestra with a spoon,

etc. Under no circumstances whatever should a chronic abscess of this kind be opened from the pharynx. Even when there is considerable dyspnœa there is always time to open the abscess from the outside; as contrasted with the acute form of abscess there is not the same urgency and there is always time for an external incision. Great care is necessary in moving the head about when the patient is under the anæsthetic if the affection be due to cervical spinal disease, as otherwise serious damage might be done by movement when the patient is unconscious.

After-treatment.—After the operation the head and neck should be immobilised in a suitable splint, preferably of plaster of Paris, an opening being left behind through which the wound can be inspected and dressed if necessary. It is also well to put the child in a Phelps' box. The question of the treatment of cervical spinal disease has already been fully gone into (see Part IV., p. 344).

GRANULAR PHARYNGITIS.—This is a condition marked by considerable enlargement of the lymphoid follicles at the back and sides of the pharynx; it is often associated with enlargement of the tonsils and with adenoid vegetations in the naso-pharynx. The condition is common in public speakers, and is one of the most frequent causes of the affection known as "clergyman's sore-throat." Its principal symptoms are perversions of sensation in the pharynx, leading to cough, hawking-up of mucus, hoarseness, a feeling of tiredness and sometimes loss of voice.

Treatment.—*When the follicles are much enlarged*, the only effectual method is to destroy them with the electric cautery. The posterior wall of the pharynx should be brushed over with a 10% solution of eucaine and a fine-pointed electro-cautery is introduced, the back of the pharynx brightly illuminated, the cautery point pressed against one of the enlarged follicles, and the current turned on. This is repeated on six or eight follicles at one sitting, and may be repeated at intervals of four days or so until all the enlarged follicles are destroyed. In the meanwhile some slightly astringent gargle should be used, and the patient should use the voice as little as possible.

When the follicles are not markedly enlarged, as is the case when the trouble is due to excessive smoking, or dyspepsia, the best treatment is to apply glycerine of tannic acid or glycerine and tinct. ferri perchlor. (one part in three) over the affected area three times daily with a large camel's hair brush. Considerable relief may also be obtained by inhalations of chloride of ammonium from one of the well-known inhalers, or by menthol sprayed through the nose by an atomiser three or four times a day.

ATROPHIC PHARYNGITIS.—A much more rebellious form is the atrophic pharyngitis, which is generally associated with atrophic rhinitis, and is secondary to that condition. There is much tenacious mucus in the pharynx which feels constantly dry; when examined, the pharynx presents a glazed reddish appearance streaked with black crusts.

Treatment.—This is much the same as that of atrophic rhinitis (see Part V., p. 313). A weak alkaline solution, such as carbonate of soda (gr. xx. to the oz.), syringed through the nostrils three or four times daily is often useful. Failing this, inhalations of chloride of ammonium, spraying the throat with menthol or painting it with glycerine and borax may be tried in turn.

SYPHILIS OF THE TONSIL AND PHARYNX.

The tonsil is one of the commonest seats of a **primary chancre** in the mouth. The *treatment* is the same as that of primary chancre elsewhere. The healing of the sore is best promoted by powdering its surface with calomel and starch powder (one part in three).

In **secondary syphilis** the tonsil is a frequent seat of the congestion that occurs in the early stage, and also of mucous patches. The latter spread from the tonsil over the soft palate and the uvula and, although they may ulcerate in the centre, their raised white edge is quite characteristic.

Here again the *treatment* must be that of secondary syphilis; calomel and starch powder is of the greatest value locally. Occasionally very severe suffering is caused and there is extreme dysphagia from the presence of these ulcers on the fauces. Under these circumstances it is imperative to get the patient as rapidly as possible under the influence of mercury, for choice by fumigation or intra-muscular injection (see Part I., p. 234).

The **tertiary forms** are however the most serious and are common on the pharynx as well as on the soft palate. Gummata rapidly form and break down, leading to deep ulceration of the mucous membrane. Unless the condition be quickly stopped, this ulceration may extend and lead to extensive cicatrisation and stenosis of the pharynx. The soft palate may also become adherent to the posterior pharyngeal wall and may thus obstruct or entirely obliterate the connection between the naso-pharynx and the pharynx proper.

Immediate and energetic *treatment* is called for here and the patient should be brought rapidly under the influence of large doses of iodide of potassium combined with mercury. Locally, nothing is so good as a mixture of calomel and starch (1 in 3) blown on to the part with a suitable insufflator. During healing every effort should be made to prevent stenosis of the pharynx and adhesion of the soft palate, but it must be admitted that this is excessively difficult. Bougies should be passed frequently into the naso-pharynx, but if the ulceration has extended on to the edge of the palate it is almost impossible to prevent some considerable closure.

STENOSIS OF THE PHARYNX.

This affection may be due to a variety of causes, of which syphilis is by far the most frequent; it follows burns, scalds, the action of corrosive

substances, and ulcerations such as lupus. It is most common in the upper part of the pharynx and is associated with adhesion of the soft palate to the posterior pharyngeal wall. Slight adhesions in that situation may not give rise to marked difficulty either in deglutition or articulation but, when the adhesions are extensive articulation is affected, the patient having a pronounced nasal voice, whilst deglutition is very imperfect; owing to failure of action of the soft palate the food constantly returns through the nose. Should the stenosis affect the lower part of the pharyngeal wall, deglutition may be interfered with in another way; there may be some degree of actual stenosis, giving rise to a condition very similar to stricture of the œsophagus high up.

Treatment.—The treatment both of adhesions of the palate and stenosis of the pharynx is undoubtedly very difficult. When the palate is adherent there is a constant tendency to recurrence in spite of repeated operations to divide the adhesions, and no plastic operation is likely to be entirely successful. All that can be done under the circumstances is to divide the adhesions between the palate and the pharyngeal wall with scissors or a blunt-pointed bistoury, taking care to do this slowly so as to avoid the possibility of doing damage to vessels which may be dragged out of position. After the operation, the freed palate must be kept from contracting fresh adhesions if possible by the frequent use of suitable instruments passed into the pharynx and swept between the palate and the posterior pharyngeal wall so as to keep the two structures separate. This may be done by the patient himself if necessary and in the early stages should be repeated twice daily; later on, once a day or every other day suffices. If it be painful, eucaine anæsthesia may be employed.

When there is stenosis of the pharynx, the case practically becomes one of stricture of the upper part of the œsophagus, and bougies will have to be passed as for that affection (see Chap. VII.). This treatment must be persisted in for the rest of the patient's life. Sometimes, as the result of syphilitic ulceration, the stenosis of the pharynx is fairly high up and consists rather in obstruction to the passage of food by bands and diaphragms than in any uniform contraction. Under these circumstances some good result may be obtained by carefully dividing these obstructions. The greatest possible care must however be taken in doing so because important vessels, such as the lingual or even the carotid trunks, may be dragged inwards by the contraction and may be endangered by operation. The best plan is to merely nick any contracted bands either with a herniotome or with a pair of blunt-pointed scissors curved on the flat, and then to forcibly stretch the structures so nicked until sufficient dilatation is produced; for this purpose general anæsthesia is necessary.

The *after-treatment* of these cases is perhaps the most difficult point, as, when the stenosis is high up in the pharynx, no œsophageal bougie is large enough to keep the aperture of the pharynx properly dilated. In some of the cases of which we have been speaking it may be necessary

to give the patient gas from time to time and to maintain the dilatation with the fingers.

TUBERCULOSIS OF THE TONSIL AND PHARYNX.

Tuberculosis probably affects the pharyngeal wall more often than it does the tonsil or the soft palate. All three conditions are however rare and are usually associated with a similar affection in the lungs or larynx. Sometimes lupus may occur in this region independently of lung disease. The ulcers are generally shallow, unhealthy in appearance and covered with a dirty yellowish layer which is partly exudation and partly degenerating tissue. Nodules are frequently seen in the neighbourhood of the ulcers. The glands are usually enlarged and caseous and the ulcers cause the patient intense pain on swallowing. Death usually occurs before long from exhaustion.

Treatment.—The *general treatment* suitable for tuberculosis (see Part I. p. 245) must always be adopted and, since the ulceration is usually accompanied by advanced tuberculosis elsewhere, it is hardly ever worth while to adopt any radical treatment even were it feasible.

The *local treatment* therefore is mainly directed to relieving the pain and this is best done by blowing orthoform on to the ulcerated surface about half an hour or more before meals. Should orthoform fail to relieve the pain, a 25% solution of menthol in parolein used in an atomiser may be employed or, if this fail, a spray containing eucaine or morphine may be used according to circumstances.

If the ulceration be limited and the patient's general condition be fairly good, an attempt may be made to scrape the ulcers with a sharp spoon after cocainising the surface thoroughly. This is particularly called for in cases where the pain on swallowing is intense. Should this attempt fail, pure lactic acid may be brushed over the ulcerated surface every day for a fortnight or longer. This as a rule soon produces healthy granulation and. although the ulcer may not actually cicatrise, it usually ceases to cause much pain. Should the pure lactic acid fail, the ulcer, if within easy reach, may be touched once or twice a week with undiluted carbolic acid; this, besides its antiseptic action, has of course a powerful anæsthetic effect.

When there is lupus in this situation, arsenic is a very valuable drug and should be given in doses commencing with 3 minims of Fowler's solution gradually increased up to 12 or 15 minims three times a day after food. The drug should be intermitted for about one week in every six as a matter of routine for fear of producing arsenical poisoning, and, should any of its symptoms occur during the administration, the drug should be given up at once and not resumed until after the lapse of some two or three weeks. In addition to this drug, thyroid extract is very valuable and should be administered in the form of tabloids containing 5 grains of the extract of thyroid gland, beginning with one and gradually increasing to

three per diem. Stenosis may follow the cure of this affection and may call for appropriate treatment (*vide supra*). Unless there be actual ulceration, no local treatment is required ; should it be necessary, it will be similar to that just described.

TUMOURS OF THE TONSIL AND PHARNYX.

These are best considered together because a malignant growth arising in the tonsil constantly tends to encroach upon the neighbouring pharynx and *vice versâ*.

BENIGN TUMOURS OF THE THROAT.—Papillomata may occasionally occur and are usually found about the margin of the fauces and the uvula. **Adenomata** are not infrequently met with on the soft palate and were at one time mistaken for a form of carcinoma ; they are however quite innocent. The other forms of simple tumours, such as **myomata**, **fibromata**, or **lipomata** are very rare and do not give rise to any trouble except by their mere bulk. Sometimes however these tumours, especially the myomatous form which usually occurs somewhat lower down in the pharynx, may become pedunculated and give rise to a pharyngeal polypus which interferes considerably with deglutition and, if very large, with respiration.

Treatment.—When a tumour of this kind is very small, it will probably pass quite unnoticed and does not therefore call for any treatment. When however, it assumes a pedunculated form, attention is drawn to it and sooner or later it will be necessary to remove it on account of the trouble to which it gives rise.

Of sessile tumours.—The methods of removing these tumours are two in number. In the first place it may be possible when the tumour is not very markedly pedunculated to incise its capsule and to shell out the growth, in the same way that a similar tumour would be dealt with elsewhere. This may be done from the mouth when the tumour is high up and can be seen properly. When situated lower down, however, it may be necessary to open the pharynx first by a pharyngotomy (see p. 69) when a good view is obtained of the tumour, so that its capsule can be freely opened and the growth shelled out. In doing this operation it is necessary to carry the incision through the capsule well down to its very lowest point so as to enable drainage to take place satisfactorily, as otherwise septic discharges will accumulate at the bottom of the capsule and decompose much in the same way as occurs in a retro-pharyngeal abscess insufficiently opened from the mouth.

Of pedunculated growths.—In the second place the growth when distinctly pedunculated may be removed by passing a ligature around its base and snipping off the tumour. This again may be done either through the mouth or after a preliminary pharyngotomy (see p. 69) according to the situation of the tumour and the length of the pedicle. If the latter be

situated high up and can be seen easily from the mouth, the patient is put under a general anæsthetic, the mouth opened with a gag, the tongue firmly depressed, and the pedicle of the tumour thus exposed. A stout silk ligature is then passed around the base of the growth by threading it through the eye of a probe of sufficient size, the end of which is bent into a suitable curve to allow it to be passed between the pedicle and the posterior pharyngeal wall. The ligature is then tightened, the polypus seized with a pair of vulsellum forceps to prevent it slipping down the throat and the pedicle cut through. Should the pedicle be very thick, it may be necessary to transfix it and ligature it in two parts. This may be done by a suitable aneurysm or hernia needle.

When the growth is so far down as to require a pharyngotomy before its pedicle can be properly exposed, the operation is of course quite simple. The pedicle is clearly exposed, is immediately under the finger and can be secured and divided. The pharyngeal wound is closed in the usual manner (see p. 67).

After-treatment.—This is very simple. For the first week or ten days antiseptic gargles containing sanitas or Condy's fluid should be employed and the patient should be restricted to liquid or semi-solid food. The ligature usually separates within the first week and there is as a rule no risk of secondary hæmorrhage. Tumours occurring in the naso-pharynx have been already dealt with (see Part V., p. 228).

MALIGNANT TUMOURS OF THE THROAT.—These may be either sarcomatous or epitheliomatous; the former usually occur as lympho-sarcomata of the tonsil. They are much rarer than the true epithelioma but their prognosis is usually bad; like the carcinomata they lead to enlargement of the glands in the neck. At first they remain limited to the tonsil and give rise to difficulty in deglutition and are often deeply ulcerated; free hæmorrhage of a most alarming character may occur from them. The tumour usually grows extremely rapidly, and quickly fills up the entire pharynx. The interference with breathing and swallowing is still further added to by the constant collection of thick tenacious mucus at the back of the throat. The treatment is removal at an early stage combined with removal of any enlarged glands. The methods of operating and the treatment afterwards, are the same as for the true carcinomata (*vide infra*).

Epitheliomata are met with in all parts of this region. In the tonsil they frequently spread from the back of the tongue to the anterior pillar of the fauces and the tonsil; in other cases they may spread in the reverse direction, commencing in the tonsil and infiltrating the tongue. They may also spread from the tonsil to the soft palate, commencing at the junction of the two structures. When they commence at the lower part of the tonsil or when they spread from the tongue to that situation, they rapidly extend downwards and involve the aryteno-epiglottidean folds. Sometimes the tumour is entirely pharyngeal, usually commencing fairly low

down just behind the tonsil. Lastly, the anterior pharyngeal wall may sometimes be affected, the growth occurring behind the cricoid cartilage either as a primary mass or as a secondary extension from the larynx.

Treatment.—In connection with the treatment of these cases various points arise.[1] In the first place the advisability of performing the operation at all must be considered and after that the method by which it should be done.

The advisability of operating at all must be decided partly by the extent of the disease and partly also by its situation. The more extensive the growth, the less favourable is the result of operation, especially when the disease is in the pharynx. Extensive enlargement of the glands in the neck is not however a serious bar to operation, as we have already pointed out in connection with cancer of the tongue (see p. 23), because this may be successfully removed. *The extent of the disease in the throat*, however, is a very different matter. After operation on extensive cases a large wound must be left which secretes pus for a long time, and distortion of the pharynx with stenosis and distortion of the orifice of the larynx are likely to occur after healing and to interfere seriously with the patient's comfort. Further, the disease is very liable to spread superficially along the pharyngeal mucous membrane for a considerable distance beyond any tangible induration and therefore the probability of immediate recurrence is very great.

The situation of the disease is most important as regards its position relative to the orifice of the larynx. When the latter is quite free, the operation is much more favourable than when the epiglottidean folds have become involved. In the latter case, the great majority of patients operated upon die of septic pneumonia, because it is almost impossible to avoid the leakage of septic material into the air-passages when the orifice of the larynx is interfered with. Hence in cases of this kind it is quite a question whether it is not better to extirpate the larynx as well as the affected portion of the pharynx should operation be decided upon at all.

There can be no question that operations for malignant disease of the pharynx are particularly discouraging, especially on account of the serious risks immediately following them. But, by taking certain precautions, these risks may be considerably diminished. The chance of recurrence is no doubt very great, but that is a risk common to all operations for cancer, and in cases of small malignant tumours of the pharynx and tonsil the results in this respect are not very much worse than those after operations on cancer elsewhere. Having regard to the distressing sufferings that these patients must undergo in the final stages, it certainly seems justifiable in suitable cases to give them the chances afforded by operation. At the same time however the operation should never be

[1] The question of operation in malignant disease of the pharynx and its results will be found fully discussed in the Lettsomian Lectures for 1896.

strongly pressed upon the patient, and, in common fairness, all sides of the question should be explained to him as fully as possible, so that he may have ample material for making an unbiased choice. We should recommend however that if the operation involves complete removal of the larynx as well as removal of the affected portion of the pharynx, the patient should be recommended not to undergo it, as no description is calculated to make him realise the deplorable condition in which the operation, even if immediately successful, will leave him. Poor patients would probably be condemned to spend the rest of their lives in the workhouse, and the operation therefore merely offers a prolongation of their misery and they will prefer to die of the original disease. Of course it is possible that a patient of a literary disposition who is well-off might find other compensations in life, even though suffering from the tremendous disadvantage that complete loss of voice, considerable deformity, etc. will entail; but on this point of course he must be left to judge for himself.

The chief dangers of the operations and their prevention.—The chief dangers of these operations are sepsis in the neck and septic pneumonia, and various precautions must be taken to avoid them. In practically all these cases the anterior triangle must be opened up extensively for the removal of enlarged glands, and spreading sepsis in the planes of cervical fascia is most likely to follow the communication between the pharynx and the neck.

Avoidance of sepsis in the neck.—With the view of avoiding sepsis in the neck it will naturally occur to one to ask whether it is not possible to remove the glands from outside whilst the pharyngeal disease is removed from within the mouth without establishing a communication between the two wounds. From the anatomical condition of affairs this is unfortunately seldom possible. Another natural suggestion is to divide the operation into two stages, the first consisting of removal of the glands, whilst at the second the wound is opened up again sufficiently to gain proper access to the pharynx. This undoubtedly renders the second operation more troublesome than if both were done at the same time and there is a risk of the wound becoming infected with cancer cells in the vicinity of the disease in the throat where the lymphatic vessels are cut across in removing the glands. On the whole we are certainly in favour of doing the whole operation at one sitting; at the same time it may be advisable to divide it into two stages when the disease is very extensive and the patient is considerably exhausted.

Prevention of septic pneumonia.—Septic pneumonia may be guarded against to some extent in various ways. The first precaution that will occur to one is the performance of a *preliminary tracheotomy*. This is almost essential for the convenience of the surgeon and the accurate removal of the disease, and it is really extremely doubtful if it adds materially to the danger of the operation. It is true that the patient is unable to cough

satisfactorily after it and thus to expel efficiently from the air-passages anything that has run down into them; but, if the trachea be plugged, this is probably not a matter of any great importance, and in the majority of these cases we think that preliminary tracheotomy is essential. It may perhaps be omitted when the disease is quite small and is situated in the tonsil or soft palate or can be removed from inside the mouth. When it is extensive, and particularly when it approaches the orifice of the larynx, it is practically impossible to operate satisfactorily without a preliminary tracheotomy, which we usually perform immediately before the operation, using a Hahn's tube (see Fig. 11). This question of preliminary tracheotomy in mouth operations has already been discussed (see Part V., p. 259).

In order to avoid the performance of this preliminary tracheotomy it may be possible to guard against the entrance of blood and mucus into the larynx by putting the patient in *the Trendelenburg position* as recommended by Keen for excision of the larynx. This position no doubt causes some embarrassment from the distension of the veins, but it need not be assumed until after the removal of the glands and until everything is ready for the excision of the tumour in the pharynx. At the same time it must be remembered that the entrance into the larynx of materials from outside is possible in spite of position, as the constant spasmodic movements of the tongue and pharynx force them into the larynx, and therefore this is not a certain means of prevention. The Trendelenburg position may also be kept up after the operation and then, no doubt, whilst the patient is lying quiet, the chances of septic pneumonia will be diminished by it; but even this is not certain, for it must be remembered that the mucus is extremely tenacious under these circumstances and, being mixed with blood, decomposes and may be a source of trouble. Both these facts are in favour of a preliminary tracheotomy. An objection to the Trendelenburg position after the operation is that it is extremely difficult to maintain, as there is a constant tendency for the head to slip down and to press uncomfortably against the pillow or the head of the bed.

A procedure that we have lately come to consider of the greatest value in avoiding septic pneumonia is *the closure of the opening into the pharynx*. We always aim at stitching up the pharynx as far as possible, so as to prevent the large wound pouring out blood and lymph and adding to the amount of discharge in the throat, and we have seen a marked advantage from this procedure. The pharyngeal wall is very extensile and, in cases suitable for operation, it is generally easy to bring the edges together. In suturing the pharynx the stitches must be so arranged that the mucous surfaces do not curl outwards, as otherwise union will not occur. An attempt is made to invert the mucous surface by catgut sutures introduced much in the manner of Lembert's in the intestine. We generally employ a double row, the outer not penetrating the pharynx. Even if this union fails, it does not matter much so long as the stitches hold for two or three days, so that the critical period for the patient, when he is unable

to swallow or clear his throat properly and has not rallied from the operation, is tided over. A large raw surface in the throat at a later date is not a matter of such serious importance.

Besides these precautions we are also careful to adopt all the preliminary measures that have been recommended in speaking of cancer of the tongue (see p. 27). *Preliminary injections of antistreptococcus serum*, removal of bad teeth and the most thorough *hygiene of the mouth* are factors of the highest importance upon which we lay the greatest stress.

Drainage.—We always drain these wounds from outside, inserting a large drainage tube close up to the line of the incision in the pharynx and bringing it out at the most dependent spot in the neck wound, so as to carry off the discharges freely. Should the fat and glands have been removed from beneath the sterno-mastoid, a button-hole is made through the skin in the posterior triangle and the tube is brought through it. Before closing the wound in the neck it is always sponged out with a solution of chloride of zinc (40 grs. to the oz.).

Arrest of hæmorrhage.—In our earlier operations we were accustomed to tie the external carotid artery, but experience has shown that this is not only unnecessary but is a very grave source of danger. When the wound in the throat communicates with that in the neck, the seat of ligature is exposed to sepsis, and the risk of secondary hæmorrhage is consequently extremely great. We may almost say that the majority of cases in which the external carotid has been tied under these circumstances have died from secondary hæmorrhage of this kind. As a matter of fact experience has shown that the bleeding during the operation is not so severe as to necessitate this procedure and, with a preliminary tracheotomy and the pharynx well packed with sponges, it need not give rise to any anxiety. The operation should be so planned that the access to the tumour from the outside is good and the surgeon is enabled to see the bleeding points distinctly and to seize them as they are divided. It is seldom necessary even to employ temporary compression of either the common or external carotid, and the bleeding, which in the earlier operations seemed likely to be a great source of danger, is in reality quite a trivial matter.

The various methods of gaining access to the primary disease in the mouth.—No definite incisions or precise methods can be laid down for these operations as they must of necessity vary enormously, and the surgeon must plan out the special operation for each individual case. We shall however endeavour to indicate the chief points in connection with them.

Removal from within the mouth.—It is very rarely that the disease can be removed from the mouth without an external incision, or at any rate without making the incision in the throat communicate with that for the removal of glands in the neck; of course if this can be done the operation is almost a safe one. As an example we may quote a small epithelioma at the junction of the soft palate and the upper

part of the tonsil which does not infiltrate the tissues deeply, or an epithelioma on the anterior pillar of the fauces or towards the front of the tonsil, and some cases of small epitheliomata occurring at the edge of the tongue with a tendency to extension on to the anterior pillar of the fauces. We have removed growths in all these situations from the mouth without opening the neck and so far successfully as regards recurrence.

Splitting the cheek.—As in the case of cancer of the tongue, access to the disease in the throat is greatly facilitated by splitting the cheek, and this we do in practically all these cases. No doubt removal can sometimes be effected without this procedure, but we should not advise that the attempt be made. To split the cheek from the angle of the mouth to the anterior border of the masseter does not add to the gravity of the operation, nor does it cause much subsequent deformity, especially in the male, while it brings disease about the anterior pillar of the fauces or the velum palati absolutely under the reach of the finger.

Removal by the thermo-cautery.—We have come to the conclusion that the thermo-cautery is the best method of removing the growth in the cases above referred to. Not only is there little bleeding, but the heat of the cautery destroys any infected epithelium spreading superficially, and thus probably adds an additional safeguard against recurrence. At the same time the operation leaves an eschar from which there is no exudation, so that there is not nearly the same amount of discharge in the early stages as there would be from a clean-cut wound. Its disadvantage is that the edges of the wound cannot be stitched together, but, as we only recommend the cautery for small growths, away from the larynx, this is not a matter of any great importance. The best plan is to mark out the area to be removed with a fine point of the thermo-cautery. If this be done the surgeon can make quite sure of removing the disease completely when the tissues become subsequently unrecognisable from the burning. Any glands in the neck can be dealt with by a separate operation which should be preferably undertaken immediately before the disease in the mouth is removed, the wound being stitched up and covered with gauze while the mouth operation is in progress.

After-treatment.—Antiseptic gargles, such as sanitas or Condy's fluid, should be used for ten days or a fortnight, and during this time fluid food only should be given by the mouth. It may be introduced along the sound side of the mouth by a tube attached to a feeder for a few days. The patient soon regains the power of swallowing.

Removal through the neck.—In the majority of cases, however, the disease must be reached from outside, and there are a large number of methods to choose from. In the first place the glands must be removed from the anterior triangle in all cases by an incision along the anterior border of the sterno-mastoid from the lobule of the ear down to at least the level of the cricoid cartilage. From this an incision should run along the hyoid bone and be curved upwards nearly to the lower border of the jaw over the anterior end of the submaxillary gland (see Fig. 23). These

flaps are dissected up, and the anterior triangle is exposed and cleared of glands as already described (see p. 55), together with the jugular vein. The digastric muscle should be thoroughly exposed as the tumour is in close contact with it. The subsequent proceedings will vary with the situation of the growth. When it is on the lateral wall of the pharynx it will be immediately beneath the finger just below the digastric muscle and all that is necessary is to retract the vessels and expose the pharyngeal wall, taking care to avoid injuring the superior laryngeal nerve. An incision is then made into the wall of the pharnyx to one side well free of the growth, and the disease clipped away with suitably curved scissors, the wound in the pharynx being afterwards sutured in the manner just described (see p. 89).



FIG. 23.—INCISIONS FOR REMOVAL OF CANCER OF THE PHARYNX. The chief incision *AB* runs along the anterior margin of the sterno-mastoid muscle. The second one *CD* commences opposite the hyoid bone and reaches the lower border of the jaw just in front of the submaxillary gland.

When the disease is situated higher up, especially when it is in the tonsillar region, freer access is necessary. When the lower portion of the tonsillar area is especially affected, the digastric and stylo-hyoid muscles should be divided, taking care to leave the hypoglossal nerve intact, so as to allow the jaw to be pushed well forwards and to expose the tonsillar region. The pharnyx is then incised, usually behind the growth and well free of it at a point best ascertained by introducing the finger into the mouth. The disease in the pharynx is thus exposed and can be removed. When the disease runs fairly high up it may be advisable to split the cheek also as far out as the masseter, so as to remove the upper part of the disease satisfactorily from the mouth while the lower is removed from the pharynx in the manner just described.

When however the disease is as extensive as this, that is to say when it affects the whole of the tonsillar region and extends high up, it is a question whether it is not better to divide the lower jaw by which undoubtedly much better access is obtained. Curiously enough the mortality in the cases in which the lower jaw has been divided is considerably less than those in which it was not done. The reason presumably is that there was a greater amount of secondary hæmorrhage in the latter cases, probably from imperfect seizure of vessels owing to the less perfect exposure of the wound. The jaw may be divided in front of the masseter or at the angle behind it. When divided in front of the masseter after division of the posterior belly of the digastric and the stylo-hyoid muscles the whole tonsillar area and side of the pharnyx are exposed to view completely and the disease can be clipped away as easily as if it were upon the surface. In order to divide the jaw, the flap is dissected well up before the jaw is sawn (see Fig. 24, *EF*).

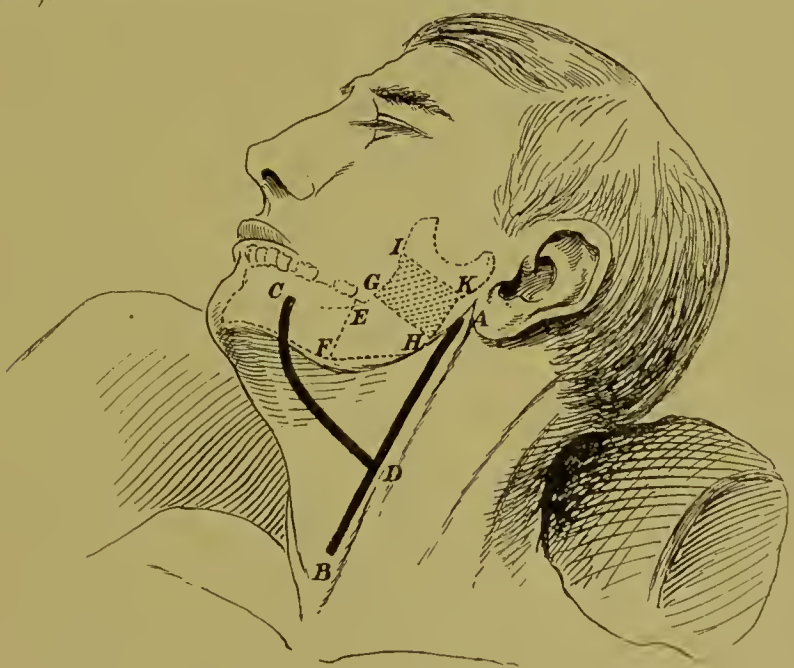


Fig. 24.—Division of the Lower Jaw in Removal of Cancer of the Pharynx. The skin incisions are the same as in the preceding figure except that *CD* is prolonged upwards well over the jaw. *EF* shows the pre-masseteric division of the jaw in the simpler cases, the shaded area *GHIK* the portion of bone removed in the more severe ones.

When the disease is situated still further back, the jaw may be divided above the angle, leaving the attachment of the masseter below, and considerable advantage may be obtained by removing the ascending ramus of the jaw altogether (see Fig. 24, *GHIK*). If the angle and the ascending ramus be removed, the functional result is bad, as the jaw is pulled to that side; but if the division be made above the angle, the ascending ramus may be removed without any marked disability subsequently, and an excellent view of the operation area is obtained when the jaw is pulled well forwards.

In some rare cases Langenbeck's division of the jaw (see p. 39), already referred to for cases of cancer of the tongue, may be of use. Usually however it is not necessary to have such an extensive incision.

When the tumour is situated about the base of the tongue, the disease may be got at very readily from outside by removing the great cornu of the hyoid bone and opening the pharnyx in that situation, being careful to avoid the superior laryngeal nerve. This exposes the base of the tongue and the epiglottis, and in a case we treated in this way the epiglottis and a wedge-shaped portion of the tongue were removed, while at the same time the left anterior triangle of the neck was cleared out. Nine months later glands were removed from the posterior triangle; six months later glands were removed from the right anterior triangle. The operation was done six years ago and the patient remained free from recurrence when last heard of.

Another method of obtaining access in these cases is the operation known as sub-hyoid pharyngotomy, namely a transverse incision through the thyro-hyoid membrane close to the hyoid bone. The latter structure is then pulled up, the thyroid cartilage pulled down, the epiglottis divided and the pharynx opened. In employing this incision care must be taken not to injure the superior laryngeal nerve in prolonging it backwards, and although this may be avoided by keeping close to the cornu of the hyoid bone, there is considerable risk of it and after all good access is only obtained in disease about the epiglottis or the aryteno-epiglottidean folds. In disease of the tonsil and the lateral wall of the pharynx much better access is obtained by one of the other methods. At the same time it is well to remember this plan for suitable cases.

After-treatment.—We have already said that the wound should be swabbed out with a solution of chloride of zinc and the pharyngeal wall stitched up and free drainage provided (see p. 90). We generally remove the Hahn's tracheotomy tube immediately after the operation, but insert a fresh one for 24 hours. If the patient can be kept in the Trendelenburg position for that length of time an ordinary tube will suffice, but otherwise a Hahn's tube should be kept in for 24 hours, after which it may be taken out and an ordinary tube substituted for two or three days. For the first three days we feed the patient by the rectum,[1] but after that food is given by the mouth, the head being kept hanging over the bed and turned well towards the sound side, whilst the food is taken in small sips and very slowly; this enables it to run down the sound side without interfering with the wound. Up to the end of the first week rectal feeding should be combined with this feeding by the mouth; after that it can generally be dispensed with. In some few cases we have had to use a stomach tube for the first few days, and if this be necessary it is best to pass it along the healthy side of the throat. In one case we were unable to dispense with a feeding tube for three weeks after the operation, but much depends upon the proper

[1] See footnote on p. 98.

closure of the wound in the neck and especially on the prevention of a sinus from the throat to the neck. Should such a sinus persist, the finger should be placed over it when the patient swallows.

When the epiglottis and base of the tongue are removed, it may be some days before the patient can swallow at all and three or four weeks before deglutition can be comfortably performed. It is stated that in epiglottic operations the rapidity with which the power of swallowing is regained is much expedited by stitching back the tongue to the mucous membrane over the lower part of the epiglottis, which is preserved as far as possible.

CHAPTER VII.

THE SURGICAL AFFECTIONS OF THE ŒSOPHAGUS.

ANATOMICAL CONSIDERATIONS.

In a person of average height the œsophagus is about nine inches in length and extends almost vertically from the lower border of the cricoid to about the level of the ensiform cartilage; the landmarks behind are from the fifth cervical to the ninth dorsal vertebra. The œsophagus has the trachea in front at its upper part and lower down the left bronchus, the arch of the aorta, the pericardium and the left vagus. Behind it rests mainly upon the vertebral column and the thoracic duct, but about three inches above the diaphragm it crosses the aorta. The pleura lies on each side of the œsophagus and the right one sends a prolongation behind it above, so that it is not easy to reach the œsophagus on the right side in that situation without damaging the pleura. Above the arch of the aorta the œsophagus is best reached from the left side; below the arch, from the right side.

The total distance from the upper incisior teeth to the stomach averages 16 inches, and Dr. J. D. Bryant[1] gives the following measurements: The distance from the upper incisor teeth to the bodies of the 1st, 2nd, 3rd, 4th, 5th and 10th dorsal vertebræ is respectively 8, $8\frac{5}{8}$, $9\frac{3}{8}$, $10\frac{1}{8}$, 11 and 15 inches. The tip of the spinous process of any dorsal vertebra (with the exception of the 1st, 11th and 12th) is just above the transverse process of the vertebra immediately below, that is to say, it just indicates the posterior margin of the rib belonging to that vertebra.

MALFORMATIONS OF THE ŒSOPHAGUS.

A number of congenital malformations may be met with for which practically nothing can be done, and which need no description here; thus, for example, communications between the trachea and the œsophagus, congenital constrictions of the œsophagus and imperforate gullet are of little importance from the practical surgeon's point of view.

[1] *Dennis's Surgery*, Vol. III.

ŒSOPHAGEAL DIVERTICULA.—This condition is similar to that met with in the pharynx (see p. 66) and most of the pouches of so-called œsophageal origin are found at the upper part of the tube and probably originate from the pharynx. As a rule the diverticulum lies towards the posterior and lateral aspect of the œsophagus at its upper part. The pouches may be of congenital formation, but some authorities consider that they are formed artificially. In any case they tend to enlarge from the constant distension with food.

Symptoms.—The symptoms are very characteristic; there is dysphagia caused by the distended pouch pressing upon the œsophagus and at the same time there is some swelling in the neck, varying according to the amount of distension of the pouch which may be diminished by firm pressure.

Treatment.—The only effectual method of treatment is to *excise the pouch*, which may be done through an incision in the neck similar to that for œsophagotomy (see p. 103), and it is well to make the pouch as prominent as possible either by passing a bougie into it or, if that cannot be done, by making the patient distend it with food. When the œsophagus is exposed the pouch is carefully defined, squeezed entirely empty and excised, the opening in the œsophagus being brought together by sutures inserted after Lembert's fashion. The *after-treatment* is exactly the same as that for œsophagotomy.

WOUNDS OF THE ŒSOPHAGUS.

These may be produced by violence from within or from without. The latter are the result of stabs, bullet wounds and the like, and as a rule call for no treatment. The most common injuries are those from within and may follow the unskilful employment of bougies, swallowing sharp-pointed or angular bodies such as needles, tooth-plates, forks, etc.; rupture of the œsophagus sometimes occurs from extremely violent vomiting.

Treatment.—Very little effective treatment as far as the wound is concerned can be employed in these cases whether the injury be from without or within. If the wound be not immediately fatal from injury to important structures such as the large blood-vessels, it is invariably followed by suppuration in the cellular tissue of the neck and generally the mediastinum, and this in its turn may lead to pyæmia or general septic poisoning. The only thing that can be done is to bear in mind the necessity of opening up the tissues of the neck in the vicinity of the wound sufficiently to provide effectual drainage. No special instructions for doing this need be given.

BURNS OF THE ŒSOPHAGUS.

Internal injuries, such as burns from caustic fluids, are most important, because, if not immediately fatal, they give rise to serious trouble afterwards. Burns from swallowing boiling water rarely occur in the œsophagus, as the water does not reach further than the lower end of the pharynx. The

chief effect of a caustic fluid when swallowed is manifested upon the more constricted portions of the œsophagus, and the entire lumen is not equally affected. Thus the escharotic effect is most marked at the junction of the œsophagus with the pharynx, and, after that, in the neighbourhood of the cardiac end. Following the gangrene of the mucous membrane produced by the caustic, ulceration occurs and extends to a varying depth, and these ulcers are extremely slow to heal and are followed by severe contraction of the œsophagus. The stricture thus formed is often extensive and irregular and offers the greatest difficulty in treatment.

Symptoms.—The symptoms are usually unmistakable. There is a history of swallowing a caustic followed by intense pain, excessive thirst, and frequent hæmatemesis; accompanying these symptoms there is often considerable dyspnœa. Death may occur very early from acute gastritis, but if the patient does not die of this, the symptoms subside after a period of intense pain, and the separation of the sloughs and gradual cicatrisation of the œsophagus ensues; this is usually accompanied by much dysphagia owing to the ulcerated condition of the œsophageal wall and the gradual narrowing of its lumen. Sometimes the œsophagus may be so destroyed as to lead to perforation; occasionally a peri-œsophageal abscess occurs.

Treatment.—There are three main indications in treatment. In the first place the chemical agent causing the mischief must be neutralised and removed; in the second, rapid healing of the ulceration of the œsophagus must be favoured; in the third, the constriction which is certain to occur subsequently must be prevented or diminished.

Neutralisation of the caustic.—The first step should be to neutralise the caustic that has been swallowed immediately the case is seen. Powdered chalk or a solution of bicarbonate of soda should be administered if the material swallowed be a mineral acid, while vinegar and water should be freely given in the case of a caustic alkali. In carbolic acid poisoning olive oil in large quantities is the best remedy.

Treatment of the subsequent ulceration.—The first essential is to insure rest to the œsophagus. This is necessary partly to prevent the inflammation spreading through the œsophageal walls and partly to promote cicatrisation. Hence *rectal feeding*[1] should be employed for as long a period as the patient will stand it without deterioration. Feeding by the mouth must of course be had recourse to should the patient appear to be suffering any ill effects from rectal alimentation alone; but this should be delayed as long as possible. The food so administered should be

[1] Dr. Otto Grünbaum has recently introduced a method of rectal feeding so planned as to be more in accordance with the requirements of the metabolism of the body than is the usual nutrient enema. The enemata he recommends contain ox-serum, milk, glucose and liq. pancreaticus. These will be referred to again in connection with gastric ulcer (see Chap. XIV.).

milk; as healing progresses, swallowing becomes less painful and the mouth-feeding may proportionately be increased and solid or semi-solid materials may be employed.

The pain, which is always very marked on account of the constant swallowing of saliva that occurs independently of feeding by the mouth, is best relieved by the administration of *morphine* in a very small quantity of glycerine; a few drops placed on the back of the tongue and allowed to trickle down the gullet has a good local effect.

Prevention of contraction.—Commencing contraction becomes evident in about three or four weeks from the separation of the sloughs, and from this time onwards every effort must be made to prevent it by passing bougies (see p. 109). The best bougies for the purpose are the conical black ones, the points of which easily pass along the canal, while the gradual thickening of the instrument upwards from the point distends its walls very gradually. Several bougies in series should be at hand; a small size should be used at first and the others should be passed until the œsophagus has been dilated up to its full size, or until a trace of blood appears upon the bougie last withdrawn. A good size to begin with is No. 14, and the dilatation should not be held to be complete until a No. 24 has been introduced; this may of course not be reached on the first or even on the second occasion. Unless there be very marked contraction when the bougies are first passed, an interval of a week may be allowed to elapse before passing them again, after which another week may be allowed to elapse unless the contraction be great; when this is the case however the bougies should be passed twice a week. As soon as the contraction is found to be stationary in the intervals between the passage of the instruments a gradually increasing interval may be given; in no case should they be passed oftener than every third day. If there be much pain in passing the bougie, the instrument may be lubricated with glycerine containing about a quarter of a grain of cocaine.

The treatment of a definite stricture of the œsophagus, by which we mean the permanent contraction of the canal after the ulceration has disappeared, is described separately (see p. 108).

FOREIGN BODIES IN THE ŒSOPHAGUS.

These are not at all uncommon and vary very widely in their nature; large boluses of food, fragments of bone, pins, needles, tin-tacks, coins, tooth-plates, etc., have all been met with from time to time. The importance of the case and the symptoms to which the foreign body gives rise vary with its seat and the nature of the impaction. Thus, large bodies generally become lodged at the commencement of the œsophagus and may give rise not only to difficulty in swallowing but also to pressure upon the upper air-passages and a rapidly fatal dyspnœa. Again, needles, pins, fish-bones, etc., may penetrate the œsophageal wall and produce cellulitis

and a peri-œsophageal abscess, or may even find their way into the large vessels, such as the arch of the aorta, and cause fatal hæmorrhage which may either occur immediately or after the lapse of some days from inflammatory softening. Needles may pass out of the œsophagus and traverse a considerable distance however without any ill effects. Small objects, such as coins, usually penetrate further down the œsophagus and, beyond giving rise to a certain amount of dysphagia, give no symptoms at all in the early stages, although if left they generally produce œsophageal ulceration and subsequent mischief. They may however remain in the œsophagus for a long time without giving rise to any definite symptoms. Ragged and irregular objects, such as tooth-plates, especially when provided with hooks, may become firmly impacted in the œsophagus, and the sharp projections rapidly ulcerate through the œsophageal wall, lead to serious peri-œsophageal inflammation, and may open into the large vessels. This kind of foreign body is the most dangerous of all because the projections become imbedded in the œsophageal wall and not only are a source of mischief in themselves but make the removal of the body by forceps through the mouth a very hazardous proceeding. All foreign bodies are likely to be arrested at one of the narrow parts of the canal, which are the upper and lower extremities of the œsophagus or the point at which the aorta crosses it.

Treatment.—In the first place this will depend on the period at which the surgeon is called in, while, in the second, it varies with the seat of lodgment and the size, shape and nature of the foreign body.

When the surgeon is called in immediately after the accident, the treatment must depend on the nature of the foreign body and the symptoms produced. In some cases the body may be only partly impacted in the upper part of the œsophagus and may project as a large mass into the lower portion of the pharynx, so that pressure upon the air-passages and urgent dyspnœa may occur. These cases have already been dealt with (see p. 68).

As a rule, when a foreign body lodges in the upper part of the œsophagus, although it may cause dyspnœa, the symptoms are not sufficiently urgent to threaten life and there is plenty of time to locate the body and to decide how to deal with it. This is a point of importance, because the same treatment should not be adopted alike for smooth rounded bodies and sharp pointed ones; and it is worth while remembering that it is very necessary to make sure that the body is actually present in the œsophagus. It is not uncommon, especially in hysterical girls, for the patient to vomit up the foreign body and still to complain of all the symptoms of its presence; in children this is a very important point.

Various measures may be taken to determine the presence and exact situation of the foreign body. When it is opaque to the X-rays these are a ready and certain means of diagnosis. When however the body is not opaque to the rays an olive-headed œsophageal sound (see Fig. 25) may

be employed unless damage is likely to be done by it. This is passed down the œsophagus until the obstruction is reached, which it is usually easy to tell as the metal end of the sound strikes it unmistakably. No attempt should be made to dislodge the body by the instrument, which should be small enough to be insinuated beyond it so that its size may be made out. The œsophagoscope, by which the body is seen directly by the electric light, has also been used for the purpose, but the method is extremely cumbrous and the information obtained by it is not of any special value.

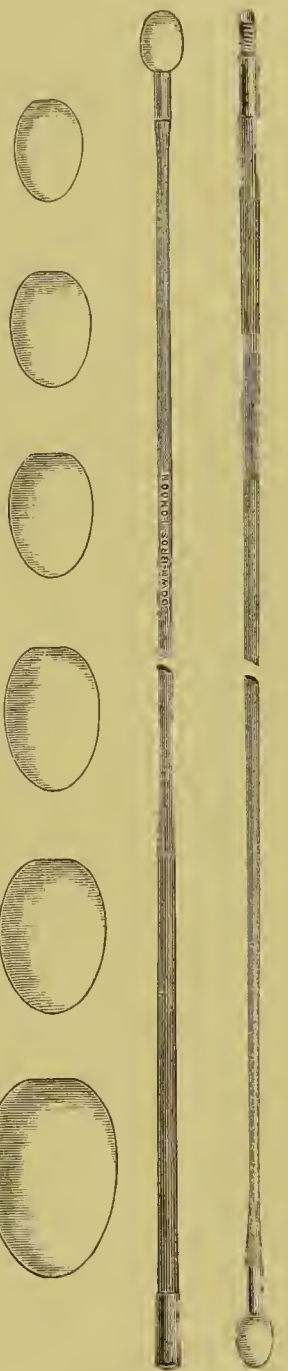


Fig. 25. — Œsophageal Sounds. The stem is made of whalebone and is flexible. The bulbous ends are made of aluminium and are made to screw on and off the stem so that one size is easily substituted for another.

After having ascertained the position and nature of the foreign body, it should be removed either by making it traverse the œsophagus and enter the stomach or by withdrawing it either through the mouth or through an opening in the neck. It must be remembered that the care observed in the manipulation of foreign bodies must increase in direct proportion to the length of time that the body has remained *in situ*, on account of the inflammatory softening of the œsophageal wall likely to result from its presence and the consequent risk of damage to the œsophagus and other important structures.

Propulsion of the foreign body into the stomach.—Boluses of food and smooth round bodies should be pushed down into the stomach. Small coins may also be similarly treated if attempts to hook them up with a coin-catcher fail. This is done by introducing a full-sized sponge probang (see Fig. 26), passing it well down into contact with the foreign body and then slowly and steadily pushing it on into the stomach; if done gently and steadily this does not cause much pain. The most troublesome time is when the foreign body is being pushed through the cardiac orifice of the stomach. A preliminary injection of morphine or a dose of chloral greatly diminishes this pain and spasm.

Although extremely useful for the cases we have just mentioned, the method should never be employed for bodies which markedly distend the œsophagus, such as large coins or objects which have sharp angles or hooks, as severe laceration of the œsophageal wall is sure to result and

probably a foreign body previously impacted in some accessible region becomes fixed in the œsophagus low down and out of reach of operative interference.

Extraction through the mouth.—When the foreign body is a very small object, such as a fish-bone, a needle, a tin-tack, or a small portion of bone, this method is not suitable, and attempts must be made to extract it



FIG. 26.—COIN-CATCHER AND PROBANG COMBINED. The lower portion is the sponge-prohang, the upper the coin-catcher. See also Fig. 28.

through the mouth. When high up in the œsophagus or partly in the œsophagus and partly in the pharnyx, attempts may be made, often successfully, to remove the body with suitable forceps (see Fig. 19). In the case of bodies impacted as low as this it is essential to employ the laryngoscope, as at this distance down a small foreign body cannot be detected or localised by the sense of touch alone.

For small smooth bodies it is well to give an emetic such as a subcutaneous injection of apomorphine hydrochloride (gr. $\frac{1}{6}$) when the foreign body may be expelled, but this method should not be employed unless the body be quite small and free of projections which might prevent its dislodgment. The same remark applies to the inversion of young children.

When the foreign body is a pointed object, such as a fish-bone, a tin-tack, pin, or needle, the umbrella or sweep's-brush probang of Fergusson (see Fig. 27) is most useful. The closed instrument is passed beyond the supposed situation of the foreign body in the same manner as the ordinary



FIG. 27.—EXPANDING OR "UMBRELLA" PROBANG. At the tip is a piece of sponge. The horsehair "brush" is made to expand (see dotted line), by pulling upon the whalebone end.

probang. In the majority of cases it is well to pass it practically to its full length, so that its lower end reaches almost to the cardiac orifice of the stomach. By traction upon the whalebone end, the sweep's brush is then made to project and the instrument thus expanded is slowly withdrawn. The bristles catch and dislodge the foreign body which becomes entangled in them and is withdrawn through the mouth. An essential point in all these cases is to be extremely gentle.

Removal of coins.—Coins invariably lodge edgewise in the œsophagus (see Fig. 28) and can therefore frequently be caught and removed by the ingenious instrument known as the coin-catcher (see Fig. 26). The instrument, properly lubricated, is gently passed along the œsophagus until its

metal end strikes the coin; this always conveys an unmistakable sensation to the operator's hand. Then the metal head of the coin-catcher is insinuated past the coin with the greatest gentleness, taking care not to use any force that might dislodge the latter, and, when well past the coin, the instrument is drawn up; the coin catches in the head of the instrument (see Fig. 28), and can be slowly and steadily brought up through the pharnyx into the back of the mouth when it may either be withdrawn still in the instrument or the patient suddenly retches and ejects the coin. There is little fear of the coin slipping out of the instrument if it be withdrawn quite slowly, as the œsophageal walls grasp it steadily and keep it in position.

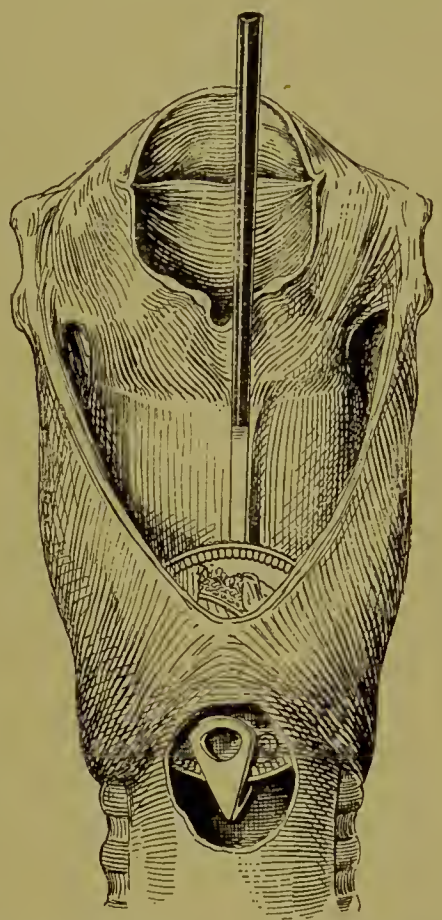


FIG. 28.—REMOVAL OF A COIN FROM THE ŒSOPHAGUS. The figure shows how the coin, lodging vertically in the œsophagus, is caught in the coin-catcher and brought up, still embraced firmly by the œsophageal walls.

Extraction through an external incision.—The most difficult cases are where large jagged, irregular bodies, such as a tooth-plate, are impacted in the œsophagus, especially low down. Any attempt either to push the body into the stomach or to remove it through the mouth is likely to fail because of the projections; not only so, but severe laceration of the œsophageal walls may occur during the proceeding. Hence a third method of treatment, namely, extraction of the foreign body through an external opening, here comes into consideration. An incision is usually made in the neck so as to reach the upper part of the œsophagus, and the foreign body is drawn up through it. When however the impaction occurs low down, it is best to open the stomach and get the foreign body down into it and so extract it; in some rarer cases it has been proposed to open the œsophagus in its course through the thorax and extract the body by direct incision over it.

Cervical œsophagotomy.—Whenever the foreign body is situated above the level of the clavicle, its extraction by œsophagotomy is comparatively easy. The first point is of course to localise the body exactly, which is done either by a skiagram, if the body be opaque to the X-rays, or else by careful exploration with an œsophageal sound (see p. 101). The œsophagus is then exposed through an incision along the anterior border of the left sterno-mastoid, running from the thyroid cartilage to the sternal notch. The

platysma and deep fascia are incised along the anterior edge of the muscle, the sheath of the vessels is exposed and the omo-hyoid defined. The fascia along the lower border of this muscle is then divided and the latter is pulled upwards, the sterno-hyoid and sterno-thyroid are pulled inwards after the fascia over their outer margin has been divided, whilst the sterno-mastoid is pulled forcibly backwards. This leaves the carotid vessels exposed in the centre of the wound, with the trachea on their inner side and the œsophagus behind it. The carotid sheath is displaced outwards, and kept out of the way with a retractor, and the larynx, together with the left lobe of the thyroid, is freed sufficiently and pulled inwards. In some cases it may be necessary, if the thyroid body be large, to ligature and divide the inferior thyroid vessels before sufficiently free access can be obtained to the œsophagus, which is now fully exposed in the wound. The œsophageal wall is carefully examined to see the position of the recurrent laryngeal nerve, which may not be seen at all, but if visible should be carefully hooked out of the way—generally forwards into the angle between the trachea and the œsophagus. The foreign body, if high up, should now be easily palpable through the œsophageal wall, and a sufficiently free vertical incision should be made directly over it through the latter to allow of its removal. A smooth rounded body does not need a large opening, which should be made in all cases as high up in the wound as possible; but an irregular body, such as a tooth-plate, requires an incision which is equal in length to its long axis. If the foreign body be not felt easily, an olive-headed sound should be passed down the œsophagus to the distance at which it has been previously ascertained that the body lies from the upper incisor teeth, and the œsophagus opened upon this. The edges of the incision are now caught up in catch forceps, held apart, and the foreign body carefully extracted by suitable forceps, any projecting arms or hooks being unhitched from the mucous membrane, or if necessary cut off by cutting pliers and removed separately. The greatest importance is attached to this point, as it is far better to cut up a body into small pieces and remove it in fragments than to cause any laceration by tugging at it during removal.

The incision into the œsophageal wall should now be sutured with catgut, the stitches being inserted much in the same fashion as Lembert's intestinal sutures, so as to bring together the muscular coat and invert the mucous membrane. The wound is flushed out thoroughly to remove any secretions that may have escaped through the opening in the œsophagus, but free drainage should also be provided, as leakage is apt to occur through the œsophageal wound. Indeed in most cases, particularly when the foreign body has been in position for some time, the best plan is to sponge the entire wound out with chloride of zinc (40 grs. to the oz.) and to leave the incision open and stuff it lightly with iodoformed gauze. This is particularly valuable when the wound is low down in the neck; when it is higher up, it may be sufficient to insert a large drainage tube leading directly up to the

neighbourhood of the incision in the œsophagus and to close the rest of the wound by sutures, after swabbing it out with chloride of zinc.

The patient should be put back to bed with the head fixed between sandbags, and rectal feeding should be employed for the first three or four days. Small quantities of boracic lotion should however be swallowed four or five times a day in order to keep the mucus from accumulating about the line of incision, and it is well to administer a little salol in the same manner; this will probably become mixed with the mucus and retard decomposition. Should perforation occur from the stitches failing to hold—as will be shown by saliva finding its way through the drainage tube—the best plan is to make the patient gargle with and swallow boracic lotion in small quantities; feeding should be practised through a stomach tube, in order to avoid food passing through the fistula. After each feed a small quantity, say half an ounce, of boracic lotion should be run through the tube so as to avoid the last drops of food being drawn out into the œsophagus as the tube is withdrawn. Healing by granulation occurs readily enough even when primary union in the œsophagus fails, and no permanent fistula is likely to result.

When the foreign body is impacted below the level of the clavicle the case is much more serious; death will then usually result before long, either from ulceration into the large vessels, which usually occurs within the first fortnight, or from ulceration into the mediastinum and fatal mediastinitis. Hence every effort must be made to remove the body, and the attempts should not be abandoned until it is found that the case is hopeless; even if the first attempt fails, important information may be gained as to the value of other instruments or other methods, and the wound may be re-opened and a successful attempt may be made later.

When the foreign body is impacted near the upper part of the thorax, a careful attempt may be made to extract it with forceps from an œsophagotomy wound in which the opening is placed as low down in the œsophagus as is practicable from the neck. The operation is done in a precisely similar manner to that already described, the opening in the gullet however being made lower down.

Gastrotomy.—When the foreign body is impacted quite close to the cardiac end of the œsophagus it may be fairly easy to remove it by performing laparotomy and making an incision into the anterior wall of the stomach that will admit the hand, which then dilates the cardiac orifice and extracts the foreign body either directly with the fingers or with suitable instruments passed up through the lower end. The steps of the operation of gastrotomy are described elsewhere (see Chap. XIII.).

Mediastinal œsophagotomy.—The most important and difficult cases are those in which the foreign body is impacted sufficiently low down in the thoracic portion of the œsophagus to prevent access being got from an œsophagotomy in the neck or from an opening in the stomach. It should be said at once however that the lower part of the œsophagus, immediately in front of the aorta, is inaccessible to the surgeon, and this structure can only

be reached in the upper part of the thorax. The best operation for exposing the thoracic portion of the œsophagus is that suggested by Dr. J. D. Bryant[1] for gaining access to the mediastinum either for exposing the œsophagus, removing foreign bodies from the bronchi, evacuating pus, or removing mediastinal tumours. His method is to turn back a flap towards the middle line and resect portions of three ribs without damaging the parietal pleura, which is pushed aside with the finger. The foreign body may then be felt and an incision for its extraction made over it; if it cannot be felt, the œsophagus may be opened on a bougie and the body reached by forceps or the finger.

The weak point of the operation is the risk of fatal mediastinal suppuration. It is almost impossible to suture the œsophagus accurately, and in addition the wound often becomes contaminated when opening it; at the same time however it must never be forgotten that a foreign body impacted in this situation will ultimately cause a fatal result, and it is almost imperative to give the patient the chance that this operation offers.

INFLAMMATORY AFFECTIONS OF THE ŒSOPHAGUS.

We distinguish between an œsophagitis and a peri-œsophagitis according as the inflammation is actually in the œsophageal walls or in the tissues around.

ACUTE ŒSOPHAGITIS.—This is very rare except as a complication of injury, such as may be produced by foreign bodies, swallowing caustics, etc. The œsophagus may however become acutely inflamed in septic conditions of the mouth, such as thrush, diphtheria, and the like, but the condition is one of great rarity.

CHRONIC ŒSOPHAGITIS.—This again is a rare disease; it may follow upon the acute form of inflammation and is common in the portion of the œsophagus above a stricture and may considerably increase the dysphagia and the pain.

PERI-ŒSOPHAGITIS or inflammation of the cellular tissues around the gullet may occur either from perforations of the œsophageal wall or may spread from inflammatory foci in the neighbouring tissues such as the glands or tuberculous spinal disease.

Treatment.—This will consist in relieving the pain, incising any large inflammatory swelling or evacuating any abscess that has formed. Tracheotomy may be required in bad cases.

ŒSOPHAGEAL SYPHILIS AND TUBERCULOSIS.

TUBERCULOSIS.—This is a very rare affection in the œsophagus, and very few cases are on record. The condition gives rise to very indefinite

[1] See *Operative Surgery*, by Joseph D. Bryant, M.D., vol. ii., p. 1046, Kimpton, London, 1901, to which the reader is referred for full details of the technique.

symptoms, dysphagia being the most marked; as a rule the cases are mistaken for cancer. Little or nothing can be done in the way of treatment.

SYPHILIS.—This is also a very rare condition, but tertiary ulceration of the mucous membrane or gummata in the œsophageal wall may be met with. Here again the chief symptom is dysphagia and the diagnosis is extremely difficult, and is practically only made because of a previous history of syphilis and by finding that improvement occurs under anti-syphilitic treatment and that there is no characteristic sign of cancer. It must however be remembered that in the majority of cases the patient is old and worn out and the syphilitic affection may be the forerunner of a cancerous one.

The treatment should be the general treatment of syphilis combined with the routine passage of bougies (see p. 109) to avoid any constriction.

NON-MALIGNANT STRICTURE OF THE ŒSOPHAGUS.

Causes of dysphagia.—Under this heading we include most of the conditions included under the term "dysphagia" or difficulty in swallowing, with the important exception of cancer of the œsophagus. This difficulty in swallowing may be due to causes external to the gullet, such as pressure from new growths in the mediastinum or the neck, from tumours originating in the vertebræ or from pressure of an aneurysm of the large vessels. It may also be caused by changes in the œsophageal walls, the result of inflammatory conditions or new growths, or it may follow blocking of the tube by foreign bodies in the interior. These latter have already been dealt with (see p. 99). Finally, it may be a purely nervous affection, due either to paralysis, or, much more frequently, to spasm of the œsophageal muscle.

All these causes must be remembered by the surgeon who investigates the causes of difficulty in swallowing. The most important of all to bear in mind is the possibility of the affection being due to the pressure of a thoracic aneurysm and therefore in every case the surgeon must examine the chest and satisfy himself that no aneurysm is present before any attempt at treatment or diagnosis by passing a bougie is undertaken. A neglect of this precaution has led to the most lamentable accidents, as a bougie passed down the œsophagus, even with great gentleness, may readily find its way into the sac of an aneurysm which has so thinned and softened the œsophageal wall by pressure that the slightest touch will perforate it.

SIMPLE CICATRICIAL STRICTURE.—This is usually the result of some antecedent ulceration of the mucous membrane such as that produced by caustics, by the impaction and long-continued sojourn of foreign bodies in the œsophagus, by syphilitic and tuberculous disease, etc. The most common cause is the ulceration due to swallowing a caustic fluid, and here, as we have already remarked (see p. 98), the ulceration occurs irregularly over the mucous membrane, is most marked at its upper and

lower ends and varies considerably in depth and extent. This leaves an irregular fibrous stricture in which considerable tracts of healthy mucous membrane are divided from one another by cicatricial bands. The obstruction to the passage of food commences early, is very marked and increases very rapidly. The irregularity in the distribution of the cicatricial tissue also tends to make the treatment of the affection by the passage of bougies a matter of extreme difficulty.

Localisation of the stricture.—Before commencing treatment an exact diagnosis should be made and the limits and precise extent of the obstruction should be ascertained. In the first place the chest should be carefully examined to make sure that the affection is not due to the presence of an aneurysm or a mediastinal tumour. The œsophagus is then explored by a suitable sound. The best form for this purpose is the olive-headed sound (see Fig. 25), which consists of a metal bulb attached to a fine flexible whalebone shaft. The metal bulbs are of different sizes and are made to screw on and off. In the first place a full-sized bulb (No. 24) should be used in order to detect whether there be a stricture or not and also the exact distance from the teeth at which it commences. This is important because a small instrument may pass through a comparatively insignificant stricture and may not be arrested until it reaches one of smaller calibre much lower down. When the first sound is arrested, the measurement to the upper incisor teeth should be taken and a smaller bulb substituted. Should this fail to pass the obstruction, a smaller size still should be employed, until one is found that passes right down through the stricture into the stomach. When this has happened, the sound is slowly and cautiously withdrawn, when the upper edge of the metal bulb will catch against the lower edge of the stricture, and then the distance of this point from the upper incisor teeth can be ascertained. By these means the situation of both the upper and lower extremities of the stricture from the teeth and consequently the length of the obstruction can be learned. It is usual to have the shaft of the bougie graduated so as to get an exact measurement. This is the only method of any value for the diagnosis of the situation of the stricture; auscultation practised during deglutition in order to detect the point at which the fluid impinges against the stricture can never replace direct examination by the sound.

Treatment.—In all cases of cicatricial stricture of the œsophagus this must be divided into medical and surgical treatment.

(a) **Medical.**—The medical treatment resolves itself into taking means to provide for the nutrition of the patient and also, by the administration of sedatives, to allay the pain and spasm in swallowing which are frequently present, especially when there is ulceration above the stricture; the difficulty in swallowing produced by the mechanical obstruction is much increased by spasm of the muscular coat. The diet should be as concentrated and as nourishing as possible, and should be either entirely fluid or at most semi-solid and free from masses which might become arrested mechanically and

cause trouble. If there be any difficulty in taking sufficient food by the mouth to support the strength, rectal feeding should be resorted to as well if the case be in the early stage and the difficulty arises more from the spasm due to the inflammatory condition than from the actual narrowing of the œsophagus. If however the latter be so extreme that the patient runs the risk of actual starvation, no time should be wasted in feeding by the rectum, but surgical measures, such as gastrostomy or œsophagostomy (see p. 112), should be adopted. The intense thirst from which many of these patients suffer in the more acute inflammatory stage should be met by large rectal injections of normal saline solution. The best sedatives to employ are opium and belladonna in small quantities, which may be given mixed with a little glycerine, so as to make a dose small in quantity and sufficiently tenacious to cling to the œsophagus as it is swallowed; this should be given a short time before food.

(b) **Surgical.**—This has two main objects. In the first place it aims at dilating the stricture and maintaining this dilatation. This is the object when the contraction, although marked, is sufficiently slight to enable bougies to be passed and when the patient can swallow sufficient food to maintain his strength. The second aim of the surgical treatment is quite different; in the late stages, when the patient is suffering not only from an extremely tight stricture but is practically starved into the bargain, it may be necessary to perform a gastrostomy to save his life.

Dilatation of the stricture.—This may be done in a variety of ways, but as a rule the best results are obtained by simple dilatation with graduated bougies.

Intermittent dilatation.—This consists in passing a bougie of suitable size through the stricture, retaining it in position for a few minutes and then attempting to pass a larger one immediately afterwards. Then, after allowing an interval of three days at least to elapse, so as to allay the irritation caused by the instrumentation, the dilatation is further proceeded with. Unless the stricture be very obstinate, this method will dilate it in the course of time, and the interval between the passage of the bougies may be steadily increased. The use of the bougies can however never be discontinued, and the patient must either pass them himself or have them passed for him at intervals for the rest of his life.

The best bougie for the purpose of intermittent dilatation is probably the silk-web form, which is quite safe and with which it is practically impossible to do any damage. The more solid forms are somewhat more dangerous, especially when there is any ulceration. It is important at the first sitting not to begin with too small an instrument; the best plan is to try one of full size in the first instance (No. 24) and to work downwards until a size is found that will pass the stricture. The point of the bougie should be softened by immersing it in a jug of boiling water and the instrument should then be lubricated with butter or glycerine; the former is the better, as some patients object to the sweet taste of the glycerine. The patient

sits facing the surgeon upright in an ordinary chair with a high back or against the wall, the head being so supported that it cannot be drawn back, or else firmly held by an assistant. The head is held erect so that the hard palate is horizontal and the mouth is widely opened. The instrument is then passed well back into the pharynx without touching the dorsum of the tongue and pressed firmly against the posterior pharyngeal wall, when the softened tip bends easily and the instrument finds its way down the pharynx. If preferred, a slight downward bend may be imparted to the tip of the instrument with the fingers before it is passed, and this is advisable, at any rate in the case of the larger instruments, to avoid undue pressure on the posterior pharyngeal wall; with the smaller sizes it is unnecessary. As the bougie passes the region of the glottis there is usually considerable spasm, the patient coughing and choking, but this only lasts for a few seconds and is greatly diminished by instructing the patient to bend the head well forward so that the saliva runs out of the mouth, and to take a few deep inspirations; this rapidly checks the spasm, and as soon as the point of the bougie has gone well beyond the laryngeal aperture the spasm passes off. The instrument should be slowly and steadily passed down the œsophagus without using any force, as spasm is very easily set up and greatly embarrasses the proceeding. Should spasm be marked, as may be the case in women, a few deep inspirations will check it.

When the stricture is reached, most careful attempts are made to insinuate the bougie through it, much in the same way as for a urethral stricture; if force be used, the point of the instrument may either penetrate the œsophageal wall or may curl upon itself and return through the mouth. It can generally be ascertained whether the bougie has found its way into the stricture by feeling that the point of the instrument is grasped, that is to say it does not pull out readily. When this is the case and the instrument cannot be passed on through the stricture without using undue force, the best plan is to leave the bougie in position for five minutes, the patient in the meantime bending the head well forwards over a basin to allow the saliva to escape; the bougie is then withdrawn. No serious attempt should be made to pass it on into the stomach, if it be grasped tightly, because it is quite possible that there may be several strictures along the course of the œsophagus, and an instrument grasped tightly by the upper one will pass entirely out of control and may do serious damage if pressure be exerted. The proper plan is to dilate the upper stricture first and then to attack those lower down.

After an interval of two or three days, a further attempt should be made in a similar manner, when it will probably be found that the bougie will pass either entirely through the stricture or considerably further down. As soon as the stricture is fairly easily passed, it is well to substitute the black conical bougies for the softer instruments, so that a little more force may be exerted and the stricture may be more rapidly dilated. Little harm can be done with these instruments as soon as a stricture is dilated sufficiently for their

points to pass through; the fine bulbous end acts as a guide for the rest of the dilating bougie. The number of bougies used at one sitting must of course vary with the progress made. It is often quite sufficient to pass one or two sizes and to begin the next sitting with the largest number employed on the previous occasion. It is certainly not advisable to push the dilatation of a stricture of the œsophagus as rapidly as may be quite safely done in dealing with strictures of the urethra.

The passage of bougies at these frequent intervals should be maintained until the stricture is completely dilated and not until then should a longer interval elapse between the sittings. As soon as full dilatation has been reached, an interval of a week may be allowed and, if the patency of the canal be maintained sufficiently by the passage of a bougie once a week for two or three months, the interval may be lengthened to a fortnight and after another two or three months, if matters be satisfactory, the passage of an instrument once a month will probably be sufficient to keep the stricture effectually dilated. In no case however must the patient go for longer than a month at a time without having an instrument passed, and, if at any time there be signs of recurrence of the contraction, the intervals must be made shorter. If the patient complains of the trouble and expense to which this exposes him, it should be pointed out that, while the maintenance of dilatation in a fully dilated stricture is a comparatively simple and painless process, the dilatation of a tight one is quite another matter.



FIG. 29.—LONG ŒSOPHAGEAL TUBE.

Continuous dilatation.—The foregoing method of intermittent dilatation suffices in the great majority of cases, but patients are occasionally met with in whom the contraction is so great and the scar tissue so dense that it does not yield readily to the intermittent passage of bougies, a condition similar to that met with in the urethra. For strictures of this kind some form of continuous dilatation, such as that employed for the urethra, may be tried. A long œsophageal tube (see Fig. 29) large enough to completely fill the stricture is passed into the stomach and left in position, the end emerging from the mouth and being fastened to the cheek with strapping or round the ear with silk. The patient is confined to bed and the head should be turned over to one side so as to allow the saliva which collects above the stricture to escape freely. Feeding is carried out by means of the tube, through which carefully filtered milk and beef-tea are introduced into the stomach as required. This tube is left in position for 24 to 48 hours, when it will be found that, whereas at first it was tightly grasped by the stricture, it has now

become considerably loosened and, when withdrawn, a tube two or three sizes larger may be passed with comparative ease, tied in and left as before, a larger one being then substituted for it in turn, and so on until full dilatation is reached. The great trouble is to persuade the patient to submit to the treatment as it is of course most irksome. The annoyance may to a very great extent be mitigated by substituting a Symonds' short tube (see Fig. 30) for the long one as soon as a moderate degree of dilatation, such as may be reached within about a week, has been accomplished. This allows the patient to swallow saliva and food and to taste the latter and, with a little practice, it can be passed easily, especially when some preliminary dilatation with the longer tubes has been practised. It is however only really suitable for cases in which the stricture is situated well below the cricoid cartilage, as otherwise the funnel-shaped end presses upon the region of the larynx and causes very considerable laryngeal irritation. These tubes will be dealt with again in connection with cancer of the œsophagus (see p. 118).

Operative procedures.—When these methods fail, recourse must be had to operative measures. Attempts have been made to divide these strictures by an internal operation (internal œsophagotomy) very similar to an internal urethrotomy, while external operations (external œsophagostomy), similar to the external urethrotomies, have also been attempted when the stricture is high up. In addition to these, forcible dilatation by instruments and attempts to saw through the stricture with a silk thread have been recommended.

Most of these operations involve an opening into the œsophagus in the lower part of the neck in order to enable the operator to get more closely in touch with the stricture and to see what is being done. This is of course a somewhat serious operation, but a tight cicatricial stricture of the œsophagus not only leads to intense discomfort but will inevitably cause the patient's death by starvation unless something be done; while on the other hand the only alternative to death by starvation is the formation of an artificial opening in the stomach through which the patient must feed himself for the rest of his life—a sufficiently gloomy prospect. Naturally, therefore, the restoration of the natural food passage is a matter of such importance to the patient's life and comfort that it is justifiable to run considerable risks in order to accomplish it.

Perhaps the simplest plan on the whole is to make a fairly free opening into the œsophagus so that the stricture can be actually inspected and the surgeon can see exactly what he is doing. The opening will generally be made low down on the left side of the neck by the operation which has been already described (see p. 103). The opening may be either above or below the stricture or may be actually somewhere in the centre of it, according to the situation and distribution of the cicatricial tissue. If it be well above, the œsophageal wall can be well defined by a full-sized bougie passed through the mouth down to the upper edge of the stricture. If on the other hand it be below it, there will be less ease in defining the œsophageal wall, but a careful dissection will make it evident.

If the œsophagus be opened at or below the chief seat of stricture, the treatment will be fairly easy. Suitable probes, directors or bougies may be gradually insinuated through the stricture upwards into the pharynx and, as the surgeon will have most of the important structures in the neck exposed in the wound, he will be easily able to avoid doing damage to them. Any fibrous bands may be nicked sufficiently with a urethrotome or suitably guarded knife to enable a good-sized tube to be passed down through the stricture from the mouth to the stomach.

When however the opening is above the stricture there is often trouble. Should the contraction be chiefly about the bifurcation of the trachea, it may be possible, by holding the edges of the wound widely apart and using a powerful reflector, to actually see the upper part of the stricture, and through it a bougie may be insinuated and passed on into the stomach. If this can be done, the other end of the bougie is passed upwards if possible and made to emerge through the mouth, and the instrument is then tied in position in order to enable the process of continuous dilatation to be carried out. Any attempt to divide or to forcibly dilate a stricture situated far down in this situation would be accompanied by such serious risks of septic infection in the mediastinum that such a procedure is not at all to be recommended. In attempting to pass the bougie through the stricture any bands or constrictions that are actually seen or felt may be nicked with a suitably guarded knife.

The great danger of œsophagotomy is the establishment of a septic wound in the neck with its accompanying risks of acute suppuration in the planes of cellular tissue in the neck; the danger of a permanent fistula is not great. Every care must therefore be taken to avoid infection, and it is well, after having exposed the œophagus and before actually opening it, to sponge out the wound with a solution of chloride of zinc (40 grs. to the oz.), and this should be repeated after the manipulations in connection with the stricture have been performed; it is well in addition to cover as much of the raw surface as possible with a piece of gauze during the further proccedings so as to avoid rubbing saliva and mucus into the cellular tissue. The edges of the œsophageal wound should be held apart and brought well up into the wound with sharp hooks on either side or by passing stitches through the cut edges. It is well after the operation not to close the wound in the œsophagus or in the neck as is usually done after the removal of foreign bodies. In the cases with which we are now dealing it may be found impossible at the time of the operation to do more than pass a bougie through the stricture from the wound in the neck, through which, therefore, the end of the bougie will emerge; the wound in the neck must consequently be left open, and the case becomes an œsophagostomy. Indeed, it is well to leave the wound open, even though a bougie be passed right through the stricture from the mouth to the stomach, as it may be impossible

to pass a larger size at a subsequent sitting without some guidance through the œsophageal opening. The wound in the neck should therefore be powdered with iodoform and lightly packed with iodoformed gauze, renewing the packing at frequent intervals so as to keep the wound widely open. As soon as a bougie can be passed through from the mouth and it is evident that dilatation by this means will suffice, the opening in the œsophagus may be allowed to close. This is best done by allowing it to close spontaneously; there is no need to stitch up the wound.

The *after-treatment* will be the same as for continuous dilatation and there will be no trouble about the feeding if a tube and not a bougie be passed through the stricture; through this the patient can be fed. Should it be impossible to get a tube through the stricture of sufficient size to feed the patient, rectal feeding may be had recourse to for four or five days (see footnote, p. 98).

The more extensive operations advocated by some are very dangerous, and we shall not therefore describe them, as in our opinion they cannot compare with continuous dilatation. When once a bougie has been passed through the stricture into the stomach and tied in position for two or three days it should be possible to pass another and larger one in its place, and, if there be difficulty in doing this from the mouth, the wound in the neck may be opened up again for the purpose.

Gastrotomy.— When there is an impassable stricture at the cardiac end, no particular advantage is gained by œsophagotomy. The stricture is much too far away from the opening into the œsophagus to allow of easy manipulation through the latter, and is more easily reached and dilated through an opening in the stomach. Large tubes may then be passed through the stricture from the cardiac end upwards into the pharynx and made to emerge through the mouth, when they are tied in as before. This procedure is of course accompanied by very considerable risk not only of shock but of possible sepsis, as the stomach requires to be freely opened and the manipulations necessary are often prolonged and extensive; still there is no doubt that the severity of the disease is such as to make it worth while in suitable cases. Apart from the risks of shock and sepsis, the result in well-chosen cases is likely to be distinctly good, as the stricture is directly under the finger and the manipulations are therefore proportionately easier, so that it may be possible to get a much larger tube through than would be the case elsewhere. This dilatation may be aided by dividing with a suitable probe-pointed knife any obstructing bands or folds that may be felt by the finger through the cardiac end. The opening into the stomach must be free and should be on the anterior surface midway between the two curvatures and as near the cardiac end as possible; before this opening is made, the stomach should be drawn well out of the wound and packed all round with abdominal cloths so as to make certain that no infection of the peritoneal surface can occur. The technique of this part of the operation

will be referred to again in connection with the stomach (see Chap. XIII.). The question of how to treat the wound in the stomach after a bougie has been successfully passed through the stricture is a matter of importance. Perhaps on the whole it is advisable to close the stomach and the abdominal incision permanently immediately the operation is finished.

Gastrostomy.—When a patient suffering from extensive and impassable stricture is unable to take sufficient food to support life and is brought almost to the verge of starvation, gastrostomy is called for to avert impending death. It must not however be thought that gastrostomy is all that should be done for the patient. It will often be found that the rest given to the œsophagus by the artificial opening into the stomach produces considerable improvement in the stricture, and not infrequently the patient can swallow far better than he could before within as short a time as a fortnight after the operation. This is probably due to the diminution of congestion and spasm given by the rest. Hence, while gastrostomy is absolutely necessary to save the patient's life and to keep up his strength in certain cases, it should only be looked upon as a temporary measure, and earnest attempts should be made after a short interval to dilate the stricture from the mouth (see p. 109). Should this be impossible, the treatment should not even stop here, but attempts should be made through an œsophagotomy opening. When once the stricture has been dilated, a secondary operation may be done for the closure of the gastrostomy wound should this not close spontaneously. The operation of gastrostomy will be described in connection with the surgery of the stomach (see Chap. XIII.); the operation that we recommend for the cases under consideration is Witzel's, as not only is it very efficient but it has the great advantage that the fistula produced is always ready to close when the tube is left out, so that, when sufficient dilatation of the stricture of the œsophagus has been obtained, all that is necessary is to discontinue the use of the tube through the gastric fistula when the opening will gradually close without the necessity of performing any secondary operation.

SPASMODIC STRICTURE OF THE ŒSOPHAGUS.

Spasm of the œsophagus is an affection chiefly met with in women between the ages of twenty and thirty. It may occasionally occur in older subjects about the menopause. As a rule the trouble is neurotic and other affections of a similar origin co-exist. The point of greatest importance in connection with it is the diagnosis. The surgeon must be very careful to be sure that no organic lesion is present. The age of the patient, the absence of hæmorrhage or signs of ulceration, the varying nature of the stricture under different conditions, the neurotic temperament of the patient and the fact that, at any rate under an anæsthetic, a full-sized bougie can be passed into the stomach without encountering any obstruction, are the principal points in the diagnosis.

Treatment.—The principal reliance must of course be placed on medicinal remedies and the employment of measures medical, hygienic and dietetic suitable for neurotic subjects. Antispasmodic drugs like belladonna, bromide of potassium, or valerian may be employed, while occasionally the Weir Mitchell treatment (see Part IV., p. 145) is called for; at first at any rate the occasional passage (once a week or once a fortnight) of a full-sized bougie, well warmed and lubricated, has a distinctly beneficial effect.

NEW GROWTHS OF THE ŒSOPHAGUS.

Tumours in connection with the œsophageal wall are of course a cause of dysphagia; they may be either simple or malignant, more frequently the latter.

BENIGN GROWTHS.—The simple tumours may be *myomata*, *adenomata*, *lipomata*, or some rare *cystic* conditions. They are all comparatively rare, and when they attain any considerable size are frequently pedunculated, with a long and narrow pedicle, whilst the tumour itself is flattened—the so-called "œsophageal polypus." Many of these are in reality pharyngeal in origin, but sometimes they actually originate in the œsophagus.

The tumour may cause obstruction to swallowing and will then give rise to symptoms which lead to its recognition. At other times it is small, does not interfere with swallowing, and is only discovered *post mortem*. When the pedicle of the polypus is very long, the tumour may be actually projected up into the pharynx during vomiting, and may then be seen.

Treatment.—A polypus of the œsophagus when recognised of course requires removal, and this will be effected differently according to its situation. When it is in reality a pharyngeal polypus which has found its way into the œsophagus, it may be comparatively easy to insinuate the loop of a snare around it and so to remove it. The loop may be got round the pedicle in various ways, by insinuating a thread around it with forceps, or on a urethral bougie, or by making the patient vomit, seizing the tumour with forceps or a hook, steadying it and getting the loop round it by means of a bent probe. When however the tumour is truly œsophageal, the pedicle will be so low down that the best plan is to perform an œsophagotomy (see p. 103), expose the pedicle, transfix and ligature it, and cut the tumour away.

CANCER OF THE ŒSOPHAGUS.—Carcinoma of the œsophagus is by far the commonest cause of stricture, and when difficulty in swallowing occurs in people who have attained middle age and in whom there is no history of having swallowed a caustic, the diagnosis is almost certainly that of a cancerous stricture; the only alternative is syphilitic disease, which is extremely uncommon in the œsophagus. The growth is practically always a squamous epithelioma, and the tumour usually occurs at the most constricted region of the gullet, either at its commencement, its cardiac end, or opposite the bifurcation of the trachea. The most common seat is probably the first of these.

The growth commences in the mucous membrane, giving rise to a tumour at one side, which may attain a considerable size before the entire circumference of the mucous membrane is affected. Ulceration occurs early and hæmorrhage is not uncommon. The tumour infiltrates the muscular walls and affects the surrounding structures or the glands comparatively early. When situated high up, it frequently ulcerates into the trachea and gives rise to a fistulous communication between the œsophagus and the air-passages. Lower down it may attack the wall of the aorta and end in fatal hæmorrhage. In others cases again it may spread by direct extension to the lungs, or the mediastinal glands may be extensively infiltrated, or a septic mediastinitis may result. Various pressure symptoms may occur from implication of nerves in the neighbourhood.

As soon as symptoms of stricture become manifest, the life of the patient is comparatively short; death usually occurs in three or four months unless means be taken to feed the patient artificially; even after gastrostomy, the patient usually dies within a year of the commencement of the symptoms, and sometimes earlier, from one of the many complications that may attend the growth. The fatal result may be due to marasmus, or to complications such as septic broncho-pneumonia from ulceration into the trachea, hæmorrhage, mediastinal suppuration, or tuberculosis, which seems to be particularly common in all cases of stricture of the œsophagus, whether simple or malignant.

Symptoms.—The chief of these is dysphagia of gradual onset, often accompanied by a loss of strength out of all proportion to the inability to take food; it is quite common to find a patient able to take a large quantity of liquid nourishment and, in spite of this, emaciating to a very marked degree. There are the usual symptoms of stricture of the œsophagus, frequently combined with those of ulceration, and there is an absence of any history of injury. A considerable help in the diagnosis is given when the growth is situated near the commencement of the œsophagus, as the air-passages are very early implicated, and the recurrent laryngeal nerve is not at all uncommonly paralysed on one or both sides.

Treatment.—The treatment of cancer of the œsophagus is at the present time entirely palliative. Excision has been practised for a growth occupying the upper end of the tube, and the patient in a few cases has recovered, but recurrence has ensued. In the most of the cases that have been operated on, the trachea has also been involved, so that the case has been practically an excision of both the œsophagus and the larynx, obliging the patient to breathe and feed through artificial openings in the neck; accidents have also happened from food passing into the trachea, and in all the cases death occurred in a few months. Considering the fatality of the disease, the formidable character of the operation, the great mutilation and the short relief afforded to the patient, these operations do not seem worth while.

The treatment can therefore only be directed to maintaining the patency

of the œsophagus as long as possible and relieving the various symptoms from which the patient suffers. The patency of the œsophagus is of great importance for the comfort of the patient, not only as enabling him to swallow his food, but also to enable him to swallow saliva. The inability to swallow saliva is one of the most distressing features of cancer of the pharnyx and œsophagus. The saliva is usually secreted in excessive quantities and accumulates at the back of the throat so that the glottis is constantly being irritated and there is incessant cough and attempts to get rid of it. This particular trouble is most marked when the stricture is high up; when low down, there is greater space for the saliva to accumulate in and it does not require to be brought up so frequently. This symptom is extremely difficult to treat by any means in our power except perhaps by Symonds' tubes (*vide infra*), but it is just in the cases where the affection is most troublesome that these are the least useful, namely when the disease is about the commencement of the œsophagus. The salivary secretion may be to some extent diminished by the administration of belladonna or atropine and the mucus may be made less tenacious and frequently removed by gargling with alkaline solutions.

Bougies.—In order to maintain the patency of the œsophagus bougies are sometimes passed. This is not however to be recommended as a method of treatment in malignant stricture, although, as we have already said, it is most efficacious in the non-malignant type. Temporary benefit may sometimes result from it, but as a rule its only effect is to irritate the growth, to make it grow much more rapidly and to hasten ulceration with all its evil consequences. The occasional passage of a bougie to examine the condition of the stricture may be useful, but nothing further than that should be done.

Intubation of the stricture.—A method of the highest value however is the introduction of a tube through the stricture and its maintenance permanently in position. This permanent intubation of the stricture may be effected either by a long tube or by the short one introduced by Mr. Charters Symonds. Each has different indications.

Symonds' short tubes.—The tube introduced by Mr. Symonds (see Fig. 30) is a great improvement upon the intubation by a long tube whenever the circumstances of the case permit of its use. This tube is a short catheter 4-6 inches long, of a gauge varying with the size of the stricture, and terminating above in an expanded funnel-shaped opening, while below it is furnished with a terminal eye. To the funnel-shaped end are attached silk threads fastened together as shown in Fig. 30 and these are brought out through the mouth and fastened around the ear or upon the cheek. The tube is inserted upon a special holder until it has passed well through the stricture, the funnel-shaped end resting upon the anterior surface of the growth and preventing the tube passing right through. The largest sized tube that will go through the stricture should be chosen, the size of the stricture having been previously ascertained by the passage of a sound. All

these tubes should be furnished with a terminal opening, as if the opening be lateral, as was originally made, blockage is very apt to occur either from lateral pressure against the stricture or from a collection of food in the blind end. The tube upon its guide is introduced exactly as is a long œsophageal tube, the whalebone guide is withdrawn and the silk threads are fixed either around the ear or to a piece of plaster upon the cheek. It is a point of practical importance to remember that these threads are liable to be bitten through, and it is well therefore to pass them between two of the teeth so that they may be guarded from harm.

The immense advantage of these tubes is that they enable the patient to swallow food naturally, and entirely abolish the trouble with the excessive salivation that is so distressing. The natural taste of food is also preserved to the patient, and it is a most comfortable method. Unfortunately, however, there is a distinct limit to its usefulness. On the one hand the tubes are distinctly more difficult to introduce than the ordinary long form, and it is not uncommon to fail to pass them when the long tube goes in comparatively easily; this, however, is mainly a matter of want of practice. A point of far greater importance is that in certain situations they are quite inadmissible for anything but a very short time owing to the pressure and irritation that the funnel-shaped end produces. This is particularly the case when the growth is situated at the upper end of the œsophagus, the end of the tube then pressing upon the larynx and causing cough, spasm, and ulceration and necrosis of the cartilages. As this is perhaps the most common seat of cancer of the œsophagus, this alone restricts their use. When, on the other hand, the growth is low down, the patient is perfectly comfortable, but there is the constant liability to blocking of the tube, especially if any error of diet be committed. Coagulated milk, etc., may collect in or about the tube and effectually block it, and perhaps necessitate its removal, and it may be impossible to repass it. If blockage occurs, it is well to try first what passing the whalebone guide down through



Fig. 30. — Symonds' Short Tube for Stricture of the Œsophagus. The right-hand figure shows the tube—it should have a terminal and not a lateral aperture—while the left-hand one shows it mounted on the introducer.

the tube will do towards clearing it. It is comparatively easy to hit the funnel-shaped opening with the guide, and when this is done it is not difficult to pass it down the tube; this is another reason why the tube should be fitted with a terminal opening as, if the opening be lateral, the guide does not necessarily clear it when passed down in this manner.

Two accidents may occur with these tubes, neither of which are of any great practical importance but which require mention, as they may cause uneasiness to a beginner. In the first place, the tube may slip down through the stricture and pass into the stomach. This may result either from undue laxity of the silk threads or because they have been bitten across. In this case nothing should be done beyond endeavouring to insert a tube of larger size. It is well not to attempt to get the tube out of the stomach even though the silk threads still remain attached and can be handled from the mouth. No harm is done; the elastic portion of the tube is digested and the rest passes on. On the other hand, the threads may get bitten through whilst the tube is in place, but even in this case no immediate steps need be taken; as long as the tube acts it will probably remain comfortably *in situ*. Should it fail to act by becoming blocked it will almost invariably be vomited up sooner or later, if careful attempts to unblock it by passing down the whalebone guide fail.

The long tube.—This method is employed only when a Symonds' tube cannot be introduced, or, if introduced, gives rise to symptoms necessitating its removal. It is obvious that a long tube passed through the stricture into the stomach must be not only unsightly but inconvenient for many reasons. The saliva cannot pass along it, the food cannot be tasted, and the only advantage is that it saves the patient from starvation, as proper nutriment can be passed through it in any quantity. Another great advantage is that when in position it need not necessarily be removed during the patient's life. It cannot suffer from any blocking that simple syringing down the tube will not relieve. This tube should therefore be employed only when Symonds' tube is inapplicable or has to be given up owing to frequent blockage, etc. It is passed in the manner described already for simple stricture of the œsophagus (see p. 109) and is fastened in position. It will require protection to prevent it being bitten through during sleep, etc. As a rule, the annoyance caused is so great that it is only towards the end of the case that it will be tolerated.

Gastrostomy.—There comes a time however in nearly all cases of cancer of the œsophagus when it is impossible to re-introduce any tube once taken out of the stricture, and the patient must then starve unless means be taken to introduce food into the stomach below the stricture. For a long time there was a great prejudice against gastrostomy, and this still lingers in the minds of some. This is probably chiefly because the old methods were not unattended with danger and did not satisfactorily prevent the escape of the gastric contents with its accompanying excoriation of the abdominal wall and suffering to the patient. More recent improvements

have perfected the method of gastrostomy, and in our experience the operation is a very excellent one, relieving the patient's suffering and prolonging his life, always provided that it be done sufficiently early in the case. We are strongly of opinion that whenever a patient is unable to swallow enough food to keep up his strength, whenever he is unable to wear a Symonds' tube, or, when wearing one, the tube becomes constantly blocked, gastrostomy should be performed at once before the patient has gone too far downhill to be really benefited by the operation. Undoubtedly some of the prejudice against gastrostomy may be ascribed to the fact that it has constantly been left to the very last, when the patient is really not in a fit state to bear the operation.

The surgeon has the choice of two methods of operating in these cases, each of which has its strong supporters. When the operation is done quite early before the stomach has undergone marked contraction the form known as Franck's or Albert's may be done with advantage. When however the stomach is much contracted and cannot be drawn sufficiently out of the wound, as is required in Franck's operation, the method introduced by Witzel is practically the only one that will give really satisfactory results. Both these operations will be described in full in connection with the surgery of the stomach (see Chap. XIII.), and we need not say more about them here than to emphasise the fact that they should be done early.

CHAPTER VIII.

DEFORMITIES, INJURIES, INFLAMMATORY AFFECTIONS AND TUMOURS OF THE NECK.

CONGENITAL MALFORMATIONS OF THE NECK.

The true congenital malformations of the neck are nearly always associated with the branchial clefts and take the form of branchial fistulæ, branchiogenic cysts, hydrocele of the neck, dermoids and pharyngeal or œsophageal diverticula. Another important congenital deformity is a supernumerary or cervical rib, and another is that which commonly goes by the name of cystic hygroma or lymphangioma of the neck.

BRANCHIAL FISTULÆ.—These are the remains of the branchial clefts, the position of the fistula depending upon the particular cleft from which it arises. The most common seat is along the anterior margin of the sterno-mastoid, especially just above the sterno-clavicular articulation. Sometimes the fistula occurs much higher up and may be met with even as high as the angle of the jaw. It is not uncommon to find a small portion of cartilage at the orifice, especially when this is low down in the neck. The fistula is usually a narrow well-defined canal, and may be long and tortuous, frequently passing between the internal and external carotid arteries. The fistula usually has an external cutaneous orifice only, and does not communicate directly with the pharynx, but it generally runs up into close connection with it, often into the region of the tonsil or the neighbourhood of the great cornu of the hyoid bone. Sometimes it runs direct towards the thyro-hyoid membrane.

Treatment.—This will depend very much on the amount of annoyance caused to the patient. The removal of a long, narrow, fistulous track of this kind is always one of extreme difficulty, and failure to remove it in its entirety means complete failure of the operation and a recurrence of the fistula. It is not at all uncommon to find that, instead of being benefited by the operation, the patient is made worse, and, upon the whole, it is probable that, unless the fistula be really a source of considerable annoyance, it is better left alone.

Sometimes however there is a connection with the pharynx or a troublesome discharge of mucus, and under these circumstances an attempt may be made to dissect out the fistula; this must be done very carefully. The first step is to pass a fine probe along the whole length of the canal, which is then exposed by an incision running along the anterior border of the sterno-mastoid. Great care is necessary to avoid cutting across the fistulous track, as otherwise the guide may be lost. Very delicate dissection is needed to isolate it throughout, and the probe should be maintained in position until the whole track is satisfactorily defined. It is then cut across above at its connection with the pharynx, and the small aperture thus made is inverted and stitched by fine catgut sutures inserted after Lembert's method. The wound in the neck is then closed, but it is well to insert a small drainage tube for two or three days in case septic infection occurs from the communication with the pharynx.

When no attempt is made to dissect out the fistula in this manner, it is well to avoid attempting to destroy the lining membrane of the canal with caustics, the sharp spoon, or the actual cautery, as these always fail, and, should they succeed in bringing about closure of the external orifice, which is the most that they can be expected to do, this will be followed by the formation of a cystic swelling in the neck.

BRANCHIOGENIC CYSTS.—When the branchial cleft is closed at both ends but not throughout, some of the intervening portion is very apt to become dilated and to give rise to a cyst, which is strictly congenital but which may nevertheless only appear comparatively late in life, remaining quite quiescent for many years. Two kinds of cysts are formed according to the character of the epithelium lining the unobliterated cleft. The most common form is the **dermoid cyst,** in which the epithelium is squamous and the contents sebaceous material of the regular dermoid type. The other form, called **hydrocele of the neck,** contains a thin mucoid fluid, and the epithelium lining the cyst is cylindrical or ciliated. These branchiogenic tumours usually occur in the upper part of the anterior triangle, usually about the hyoid bone, between it and the mastoid process. When large they may lift up the sterno-mastoid and project into the posterior triangle, or they may be mainly in the latter situation; they always however derive their origin from the branchial cleft. They may project above into the floor of the mouth and may be mistaken for ranulæ. As a rule the hydrocele of the neck is noticed at birth, or immediately afterwards, whereas the dermoid form is not discovered until adult life. Both forms gradually increase in size, and in some rare cases they may suppurate, or may lead subsequently to the development of carcinoma. It is probable that primary carcinoma of the neck occurring without evident lesion of the mucous or cutaneous surface has its origin in one of these dermoid cysts.

Treatment.—This should be complete excision; nothing short of this is likely to be of any use because, unless the epithelial lining be entirely

removed, not only will the cyst refill but inflammation will occur around and removal of the cyst wall will be much more difficult. In dissecting out the cyst it must be remembered that it is often closely connected with the vessels and other important structures in the neck, and therefore the dissection must be very carefully carried out. Sometimes a portion of the cyst is so adherent to some important structure in the neck that it cannot be entirely taken away. Should this be the case, the utmost care should be taken to denude it of its epithelium by cutting, scraping and cauterisation; even this is uncertain and therefore every attempt should be made to remove it. Cystic hygroma is described on p. 138.

SUPERNUMERARY OR CERVICAL RIBS are not infrequently met with running from the transverse process of the sixth cervical vertebra to the scalene tubercle on the first rib. The supernumerary rib is generally fairly well formed but may be anchylosed at each end; as a rule the spinal end alone is anchylosed, the other end being free. For many years the patient may not recognise that any deformity exists, and usually it is in women only that it is noticed. It is commonly the visible deformity that calls attention to the case, and this is often the only complaint made. Sometimes however there is tenderness in the posterior triangle, with some pain down the arm or perversion of sensation in the nerves of the brachial plexus which may be displaced by the bony process. In many cases the condition is entirely stationary and the symptoms are extremely slight and do not warrant any interference. Occasionally however the brachial plexus and the subclavian artery are lifted up and displaced by the rib and serious pressure symptoms are produced. Under these circumstances it may be necessary to interfere.

Treatment.—Operative interference should only be undertaken when severe symptoms are present; for the mere deformity, which is often extremely slight, it is hardly justifiable to submit the patient to a tedious and somewhat severe operation involving a very careful dissection of an important region. Moreover the scar that must be produced by the operation is almost as important a deformity as the swelling itself. When however symptoms referable to the brachial plexus or the subclavian artery, such as pain or retardation and diminution of the pulse at the wrist, are met with, it is necessary to cut down upon and remove the bony process. This is a very difficult matter indeed as the pleura lies immediately behind and is usually very intimately connected with the periosteum of the rib and it is very difficult to remove this without puncturing the pleura. The brachial plexus and the subclavian artery lie over the front of the rib, but they are generally easily displaced to one side. The bone should be removed by shelling it out of its periosteum and this is done as follows:

Operation.—A curved incision with its convexity backwards is made in the posterior triangle commencing at the centre of the posterior margin of the sterno-mastoid, curving backwards and downwards nearly to the anterior margin of the trapezius and then forwards along the clavicle to the sterno-

mastoid again (see Fig. 31). The flap thus marked out is raised well forward, the deep fascia is opened, the external jugular vein pulled inwards or divided, the posterior edge of the sterno-mastoid either pulled firmly inwards with a large retractor or divided to some extent, the omo-hyoid defined and pulled up and the subclavian artery and the brachial nerves lying upon the rib defined. These must now be displaced, and usually the nerve cords can be pulled upwards and the subclavian artery downwards, but very great care must be taken in doing this not to exert undue traction upon the nerves, as



FIG. 31.—INCISION FOR REMOVAL OF A CERVICAL RIB. The same incision also serves for exposure of the brachial plexus (see p. 136).

otherwise hæmorrhage into them and serious subsequent symptoms may occur; they should be displaced in various directions according as the separation of the process proceeds. The best way to avoid damage to surrounding structures is to incise the periosteum freely, generally along the anterior surface of the process, and to insinuate between it and the bone a suitably curved periosteum detacher, by which the periosteum is stripped off in all directions. As soon as this has been effected to some extent, a chisel or a pair of cutting pliers is slipped in between the periosteum and the bone near its attachment to the spine and the rib is cut across; if the latter be anchylosed at its distal end, a similar procedure may be carried out there. Having thus loosened the bone, it is usually a matter of very little difficulty to twist it out with the aid of a few touches of a periosteum detacher and to leave the periosteum intact. The stump of the rib is next carefully shaved down with a chisel or cutting pliers so as not to leave any marked projection or any sharp edge against which the vessels or nerves might be damaged.

When the bone has been thus got rid of, the periosteum should be picked up and as much of it removed as can be done safely. This is important, as, if left behind, fresh bone would be developed in it and a partial recrudescence of the trouble might occur; at any rate there might be considerable pressure upon the structures from a callus-like mass thrown out around them. It is of course possible that the pleura may be

pricked in doing this, but, should this happen, it is not an accident of very great moment, although from the severe immediate symptoms to which it gives rise it is advisable to avoid it if possible. At the time of the puncture, air passes into the pleural cavity, the lung collapses, and the patient's aëration may suffer considerably; he becomes blue and collapsed, and the breathing is very embarrassed. This however usually passes off very quickly, especially on the administration of stimulants. The puncture in the pleura should be closed by sutures; the air in the pleural cavity rapidly becomes absorbed, and in a short time the conditions are again normal.

TORTICOLLIS.—By torticollis or wry-neck is meant an affection in which the sterno-mastoid muscle mainly, and sometimes the other muscles of the neck secondarily, undergo contraction which is either constant or spasmodic. This produces a very marked and characteristic deformity termed "wry-neck." Usually the affection is limited to one side; but in some cases both muscles are affected, in which case however there is a very different deformity, the head being tilted strongly backwards. The condition may be acute, permanent or spasmodic.

Acute torticollis.—Temporary contraction of one sterno-mastoid is not uncommon. There is, for instance, the condition generally spoken of as "stiff-neck," which is presumably some rheumatic inflammation of the sheath of the muscle. This commonly arises after exposure to cold, and gives rise to a temporary contraction of one or even both sterno-mastoids with characteristic deformity. Under suitable treatment this condition passes off in a few days and leaves no ill results.

Contractions of the sterno-mastoid may also occur in connection with acute inflammations of structures in the immediate vicinity, particularly the glands in the anterior and posterior triangles. This is not so common in connection with tuberculous glands as in the more acute inflammations of a septic origin. Sometimes it may follow an eruption of boils in the neighbourhood.

A very important cause of wry-neck is cervical spinal disease; when the disease mainly affects one side of the vertebræ the sterno-mastoid on that side is very apt to be contracted, and a typical wry-neck is produced. This is a possible cause that should never be forgotten when examining a patient for wry-neck. In rheumatoid affections of the cervical spine some amount of wry-neck is often present. Neither of these forms is necessarily acute, but they are both inflammatory in origin and may well receive notice here.

Treatment.—The treatment of acute wry-neck will, of course, depend entirely upon the primary condition, and will consist essentially in a removal of the cause.

In the ordinary stiff-neck from cold the best treatment is rest, together with the application of hot fomentations frequently renewed, the administrations of a dose of calomel (gr. iii.-x.) followed by ten-grain doses of

salicylate of soda thrice daily; when the patient is at all gouty, colchicum and iodide of potassium added to the salicylate of soda give excellent results. The affection is often excessively painful in the early stages, and for this ten grains of Dover's powder may be given at night to enable the patient to get sleep. As soon as the more acute condition has passed off, which will be in two or three days, the affected side may be rubbed with various liniments, particularly the linimentum terebinthinæ aceticum or equal parts of lin. belladonnæ and lin. camph. co. The rubbing should be carried out three or four times a day, and the neck should be wrapped up afterwards in a mass of hot cotton-wool. As a rule, the condition passes off completely in a week or ten days; but if there be any tendency for it to become chronic, a course of vigorous massage, accompanied by occasional blistering or a visit to one of the watering places, such as Bath, Buxton, or Harrogate, will generally put matters right. Turkish or hot-air baths are useful under these circumstances.

In cases secondary to acutely inflamed glands the treatment must be directed to the latter (see Part II., p. 181). As soon as these subside, the wry-neck clears up. When *secondary to spinal disease* the latter must be treated on appropriate lines (see Part IV., p. 354). Rheumatoid affections must also be treated on the lines laid down in Part IV., p. 151.

Congenital torticollis.—When wry-neck occurs at or immediately after birth it is usually spoken of as congenital. It is a matter of considerable doubt whether children are ever actually born the subjects of this condition. It may possibly be so in rare instances, but apparently the great majority of so-called congenital cases develop after birth, usually as the result of some partial rupture of the sterno-mastoid during delivery. In other rare cases the torticollis follows paralysis of the muscle on the opposite side. The true congenital form is attributed by some to developmental arrest, in support of which view the asymmetry of the face and head which so usually accompanies it is cited. Very rarely permanent wry-neck is of distinctly non-congenital origin as it may follow rheumatic inflammation of the muscle or injuries in adolescents.

Pathology.—Congenital wry-neck is caused by a permanent contraction of the sterno-mastoid muscle which undergoes profound changes. Besides the sterno-mastoid, other muscles, such as the trapezius, the splenius capitis, etc., may be affected secondarily, but the shortening in these is usually temporary and is readily overcome when the sterno-mastoid condition has been rectified. The alteration in the latter muscle is apparently a fibrous transformation, new fibrous tissue being formed around the muscular fibres which become compressed and disappear, leaving the affected area of muscle almost entirely transformed into a band of firm fibrous tissue. This condition is not limited to the muscular fibres but affects the sheath of the muscle, so that division of the former alone does not suffice to rectify the deformity. The sterno-mastoid as a rule is very unequally affected; generally the sternal head undergoes much more extensive alteration than

the rest of the muscle and in some the transformation is limited to this portion which can be felt standing out as a hard rounded fibrous cord; the result is considerable shortening.

Along with the shortening of the sterno-mastoid, there is well-marked arrest of development of the corresponding half of the head and face. This diminution in size of the affected side may occur in acquired torticollis as well as in the congenital form, so that the lesion is evidently secondary to the development of the wry-neck and is not a mere congenital deformity. It is said that atrophy of the corresponding cerebral hemisphere has also been found, and both conditions have been explained on the theory of insufficient blood supply to that side partly by kinking of the carotid artery, and partly by the fibrous thickening in the carotid sheath, which occurs in bad cases.

Associated with the torticollis there is always curvature of the cervical spine, the concavity being on the affected side; in very marked cases there is a compensatory curve in the dorsal region. As a rule however this curvature does not lead to any permanent alterations in the bones and does not offer any obstruction to the reposition of the head after the sterno-mastoid has been divided. It is always important to examine the case carefully to make sure that it is one of primary torticollis and secondary curvature of the spine and not primary tuberculous cervical spinal disease to which the shortening of the sterno-mastoid is secondary.

Treatment.—Attempts to stretch the muscle by continuous extension or by any form of apparatus are futile, and nothing but operative measures will succeed. There are two chief points in the treatment; firstly, to remedy the shortening of the sterno-mastoid, and secondly, to maintain the head in its proper position.

Operation.—In order to get the head back into place it is absolutely essential to divide the sterno-mastoid muscle and its sheath. The splenius, trapezius, omo-hyoid, etc., which may also be secondarily affected, will generally yield to proper manipulative treatment subsequently and do not require division; their shortening is only temporary and is not due to fibrous changes. As a rule, both the sternal and clavicular heads of the sterno-mastoid must be divided and not only that but the sheath must be freely divided also; otherwise the operation is likely to be unsuccessful. There are two methods of doing this, the one by tenotomy or the subcutaneous method, the other by division of the muscle through an open incision. The open operation is so infinitely superior to the subcutaneous one that it is practically the only method that should ever be employed, and it is the only one that we shall describe. Anyone who performs the operation through an open incision can easily satisfy himself that, in order to effect a cure of the torticollis with the precision and completeness that is essential, the open incision is absolutely necessary and it is quite impossible not only to perform the subcutaneous operation without great risk but to perform it effectually. So great is this difficulty that, even before the days of anti-

septic surgery, when an open wound was constantly liable to be followed by suppuration, surgeons actually advocated that this operation should be performed through an open incision. The only possible objection to the open operation is that it produces a scar which may contract, but this can be so arranged that it does not really show and, if done in children as this operation nearly always is, the scar will become soft, supple and practically unnoticeable as time goes on.

The open method.—Various incisions have been employed. A common one is an incision about half an inch long and about half an inch above the clavicle, running forwards from the posterior border of the sterno-



FIG. 32.—INCISIONS FOR THE OPERATION FOR WRY-NECK. The one on the left-hand side is the one first described in the text, the one on the right-hand side being that mentioned in the footnote. The curved incision runs a little too far forward at each end.

mastoid. This is insufficient to expose the whole width of the muscle, but, by pulling the incision forwards, the anterior part can be seen. Other surgeons employ a vertical incision along the posterior margin of the sterno-mastoid from the clavicle upwards in order to expose the jugular vein as it turns round behind the muscle. The vein is then retracted and, by pulling the flap forward, the anterior part of the sterno-mastoid can be exposed. Both these incisions have objections. The transverse one lies over the actual point of division of the muscle, and the scar is very apt to become puckered in the interval between the divided ends. The scar of a vertical incision is likely to contract and form an ugly ridge, while at the same time the incision is a very awkward one through which to operate. To avoid these difficulties we are accustomed to employ a curved incision commencing about a quarter of an inch behind the anterior border of the muscle and an inch and a half above the clavicle which is carried backwards and downwards over the anterior third of the posterior triangle, curving forwards below over the clavicle to about opposite the centre of the sterno-mastoid (see Fig. 32). This flap is turned forwards and detached from the outer surface of the sterno-mastoid until the anterior margin of the muscle is quite free.[1]

[1] The incision above described is of course rather extensive and may be objectionable for æsthetic reasons in adolescent girls; a modification of Kocher's incision for thyroidectomy, namely an oblique incision lying along the fold of the neck and over the lower third of the sterno-mastoid, may be then substituted for it with advantage. This gives good access to the muscle, and at the same time can be sutured so as to leave little visible scar.

The external jugular vein is freed and pulled backwards and the finger is insinuated beneath the sterno-mastoid, so as to separate the latter and its sheath from the deeper structures, until it emerges around the anterior border. The muscle can now be divided without the least danger to the vessels beneath which are guarded completely by the finger. The whole muscle should be divided obliquely upwards and backwards from the anterior margin; this prevents any wide separation between the ends. Care must be taken to see that the sheath of the muscle formed by the deep cervical fascia is divided to the same extent as the muscle itself.

The head is now brought into a strongly over-corrected position by an assistant and the wound is carefully explored with the finger to ascertain if any contracted bands remain undivided; these are very commonly found. In bad cases the deep cervical fascia in the neighbourhood is strongly contracted and many bands require nicking, and we have actually had to divide the common carotid sheath before the tension was sufficiently relieved. As a rule the greatest difficulty is met with when rotating the head to the opposite side, as the contracted bands are then put most on the stretch. In order to practise this properly the head of the patient should be brought clear over the operating table and should be rotated firmly from side to side until it rotates freely. The head should then be bent over the opposite shoulder and any tense muscles should be carefully kneaded while the patient is still under the anæsthetic and before the wound is stitched up. When this has been done, the wound is washed out and stitched up without a drainage tube.

The maintenance of reduction.—In many cases that are not of long standing all that is necessary after the operation is to place the patient flat on the back with the head fixed in sandbags for a few days until the wound has healed. In ten days the stitches may be taken out, and the wound will be healed, and manipulations, massage and voluntary movements of the muscles can be commenced, these being often quite sufficient without the application of any apparatus. In many cases however, and especially in young children, some form of apparatus is necessary for a time at any rate. For the first three weeks after the operation sufficient extension may be made by a weight and pulley attached to a head-stall, catching the head beneath the chin and the occiput. The head of the bed should be raised fairly high on blocks so that the weight of the body acts as a counter-extending force. A weight of 3-5 pounds, according to the patient's age, will usually suffice. If the child wriggles about at all in bed, sandbags should be laid on either side of the head to fix it.

A useful plan in combination with this is to hold the head firmly in the over-corrected position and then to apply plaster of Paris over the affected side of the head and neck. Several thicknesses of ordinary house-flannel are cut to a suitable pattern, the outer ones impregnated with

plaster and bandaged on; plenty of plaster should be applied, so that the apparatus is fairly heavy and thus tends to restrain movement by its own weight. When dry, the bandages may be cut off and the apparatus kept in position by one or two straps or handkerchiefs passed beneath the opposite axilla. It can be lifted off easily at any time to wash the patient, etc., and, if well moulded to the neck and made heavy, it acts better than sandbags out of which the child is apt to wriggle its head.

After two or three weeks the child may be allowed to get up, and then in the bad cases it is well to employ some form of apparatus such as Sayre's or some modification of it (see Fig. 33), which consists of a circlet, passing round the forehead and beneath the external occipital protuberance, attached to the posterior part of which on the sound side, close to the mastoid process, is a stout indiarubber cord, the other end of which is attached opposite the anterior fold of the axilla on the same side to a band passing round the upper part of the chest. This keeps up a constant elastic opposition to the recurrence of the deformity. While this apparatus is being worn, massage and suitable muscular exercises, both active and passive, should be employed to soften the parts and increase the power of the muscles. The apparatus may require to be worn for several months.



FIG. 33.—APPARATUS FOR USE IN TORTICOLLIS. This is applied after division of the sterno-mastoid muscle.

Spasmodic torticollis.—In this condition there are clonic spasms of the sterno-mastoid and sometimes of the other muscles of the neck, especially those in the sub-occipital triangle, the spasms occurring at varying intervals and the affection being sometimes accompanied by a certain amount of permanent contracture of the muscle. The actual form and character of the movements vary in different cases. Sometimes the spasm is regular and occurs comparatively slowly and lasts for a long time. In others there is a very frequent and rapid twitching of the muscles.

The factors that favour the occurrence of this spasm vary. In bad cases there may be constant spasm whenever the head is erect; in some it ceases when the patient lies with the head supported on a pillow, and we have found the same thing happen when the patient stands up with the head against the wall. The pathology of the condition is quite unknown, but it is certain that, when once started, it is much increased by any mental trouble or sudden noise. The spasms are not painful as a rule, but in the intervals between them there may be tonic contractions which are painful.

Treatment.—This may be divided into medicinal and operative measures.

(a) **Medicinal.**—When the condition is slight and does not cause much trouble, palliative measures may be adopted in the first instance. Any source of mental anxiety must if possible be removed, whilst treatment directed against any neurotic element should be adopted. Various nerve sedatives, such as the bromides, chloral, or, in bad cases, subcutaneous injections of morphine, may be employed, whilst the patient is at the same time placed amidst cheerful surroundings and under good hygienic conditions.

The galvanic current is perhaps the most useful method of local treatment, counter-irritation being quite useless. The current should be passed from above downwards along the course of the spinal accessory nerve and should also be applied directly to the muscle. The positive pole should be placed over the spinal accessory high up, the negative lower down. A very weak current should be employed at first, gradually increased, and there should be a daily application.

Another method that is sometimes useful is a head-rest, on the principle that support to the head will often cause temporary cessation of the convulsions. We have treated one case with great success by providing a photographer's head-rest attached to a poroplastic band around the chest, so that the patient could rest his head against it whenever he chose; the head was not fixed into the apparatus. It was very remarkable how the spasm was moderated and often entirely ceased whenever the patient rested the head back.

(b) **Operative.**—In severe cases and those that resist this treatment, the patient's comfort is so severely interfered with that operative measures are called for. These consist in resection of the spinal accessory nerve together with branches of the cervical plexus in the more severe cases. Simple nerve-stretching has been practised, but is of very little value. Simple neurotomy also fails to give a good result, and nothing but excision of a considerable portion of the nerve is of any use. The course of the nerve after its exit from the jugular foramen may be represented by a line drawn at right angles from the centre of another line joining the tip of the mastoid process to the angle of the jaw. The nerve emerges from beneath the posterior belly of the digastric muscle, just superficial to the transverse process of the atlas, and runs downwards and backwards to pierce the sterno-mastoid a little lower down.

Neurectomy of the spinal accessory.—The patient lies upon the back with the head turned towards the healthy side and, after the parts have been thoroughly shaved and purified, an incision two inches long is made along the anterior border of the sterno-mastoid from the tip of the mastoid process downwards. The skin, superficial fascia and platysma are divided, the anterior border of the sterno-mastoid is defined, the deep fascia of the neck is opened, and the muscle is drawn well backwards with retractors.

Then the digastric muscle is defined with the finger or a dissector, and the spinal accessory is seen coming from beneath it on its way to perforate the sterno-mastoid. If there be any difficulty in finding the nerve, the best landmark is the transverse process of the atlas, immediately superficial to which the nerve will be found. As a rule, when using the finger or a dissector in this region, twitching of the sterno-mastoid will be set up whenever the nerve is touched. There are no important structures likely to be damaged in this neighbourhood. As soon as the nerve is found, it is hooked up clear from the surrounding structures, and as much as possible is removed. The wound is closed without a drainage tube, the usual dressings are employed, and the head is fixed in a moulded collar of gutta-percha or the plaster of Paris splint recommended for congenital torticollis after operation (see p. 131). There may be some difficulty experienced in getting the head into proper position from the long-continued mal-position and the consequent shortening of the muscles, but these should be thoroughly stretched under the anæsthetic; it may be necessary afterwards to employ Sayre's apparatus for ordinary torticollis (see Fig. 33), or the head-rest just described (see p. 132).

When the spasm is definitely limited to the sterno-mastoid and the trapezius, the operation is followed by great benefit; indeed some cases are almost cured. When however other muscles of the neck are implicated, partial improvement alone is seen; this however may be quite sufficient to make the patient comparatively comfortable, and nothing further may be necessary.

Resection of the cervical nerves.—When however there is spasm of the posterior muscles of the neck, and this persists after the neurectomy of



Fig. 34.—Keen's Incision for Resection of the Cervical Plexus.

the spinal accessory, the surgeon may again have to interfere and divide the nerves supplying these muscles. In order to paralyse the deep rotators of the head the posterior branches of the first, second and third cervical nerves should be divided. Keen advises the following operation.

A transverse incision (see Fig. 34) is made half an inch below the level of the lobule of the ear extending from the middle line posteriorly forwards for about three inches. The trapezius is divided throughout the length of this incision, and the surgeon then dissects up this muscle and finds the great occipital nerve as it leaves the complexus and enters the trapezius. The nerve emerges from the former muscle about half an inch below the incision, through the intermuscular aponeurosis of the complexus. The complexus is divided transversely on a level with the nerve, and by careful dissection the latter is followed downwards until its origin from the posterior division of the second cervical is reached. A portion of this is then removed. The obliquus inferior muscle is then identified, and the sub-occipital nerve, which passes immediately above the muscle towards the spine, is followed back. The nerve leaves the spinal canal between the occipital bone and the posterior arch of the atlas lying beneath the vertebral artery. It then enters the sub-occipital triangle, which is bounded by the obliquus superior and inferior and the rectus capitis posticus major. About an inch lower than the sub-occipital nerve, and beneath the complexus, will be found the external branch of the posterior division of the third cervical nerve which supplies the splenius. Portions of both these nerves are removed. Satisfactory results have followed this operation.

CICATRICIAL DEFORMITIES OF THE NECK.

These require only very short mention here as their treatment does not differ from that for cicatricial deformities elsewhere. Very severe distortion of the neck is not infrequently met with from cicatricial contraction, such as that occurring after an extensive burn which pulls down the skin of the neck, binds down the chin, and pulls the head to one side so as to produce a condition closely resembling torticollis.

The **treatment** here does not differ from that of cicatrices after burns elsewhere. Skin-grafting, following division and removal of fibrous bands, or, if necessary, plastic operations should be adopted, and these have been fully described (see Part I., p. 177).

INJURIES OF THE NECK.

Very little need be said about these, as the treatment is that common to similar affections elsewhere.

WOUNDS.—A very common form of wound is "cut throat," which has already been considered (see Part V., p. 236).

Wounds of the large veins of the neck are of importance partly on account of the hæmorrhage but mainly from the risk of the entrance of air into the vein. This subject has already been dealt with (see Part I., p. 142).

Wounds of the large arterial trunks are of course followed by immediate death if the vessel be divided in a wound of any size, by the formation of a false aneurysm, an aneurysmal varix, or a varicose aneurysm when the vessel is punctured and the skin wound closed, or by a true aneurysm when the wall of the vessel is simply contused. The occurrence of aneurysmal varix and true aneurysm following bruising of the vessel wall has been noticed in a large number of cases of wounds caused by Mauser bullets in the recent South African campaign.

Injuries of the nerves of the neck may follow wounds or violent blows. The most important of these nerves is the *vagus*; unless this be wounded in the course of an operation the injury is generally accompanied by fatal damage to the vessels. It is remarkable that even the removal of a large portion of the vagus on one side does not necessarily prove fatal, nor indeed does it seriously inconvenience the patient (see p. 24). Should both pneumogastrics be divided, the patient usually dies of pneumonia. The division of one vagus is followed by paralysis of the vocal cord on that side owing to paralysis of the recurrent laryngeal nerve.

Among other nerves which may undergo injury may be mentioned the branch of the *spinal accessory* which runs from the sterno-mastoid to the trapezius. After piercing the former muscle a little above its centre it runs obliquely downwards and backwards to the under surface of the trapezius which it joins at about the junction of the middle and the lower third. This nerve is very apt to be injured in the removal of glands from the posterior triangle and it is so small that attempts to bring its ends together are generally futile. The patient suffers from slight drooping of the shoulder afterwards and difficulty in shrugging the shoulders.

Injuries to the *brachial plexus* may follow violent blows, and are especially common when the blow is delivered in a downward direction or when the arm is violently pulled. According to the particular portion of the plexus injured there will be various paralyses of the upper arm. The same structures may be pressed upon by callus or compressed by cicatricial tissue, as after the passage of a bullet. The *cervical plexus* may also be similarly damaged, although much more rarely.

The thoracic duct is another of the important structures in the neck that may sustain a wound. This subject has been fully dealt with already (see Part II., p. 173).

Treatment.—Of wounded vessels.—We have already dealt fully with the injuries to arteries and veins both immediately after the accident and subsequently, when aneurysm, aneurysmal varix, etc., form (see Part II.). The remarks made there apply to similar injuries in the neck.

Of injuries to the nerves of the neck.—The treatment of nerves that have been divided in the neck is of course exactly similar to that required for nerves similarly affected in other regions. As most of the nerves injured in this region will be divided during the course of an operation, the divided ends can usually be seen easily and, if the nerve

damaged be of any size, such as the vagus or even the spinal accessory, an attempt may be made to bring the ends together by sutures in the usual way (see Part II.).

Of injury of the brachial plexus.—The brachial plexus may be easily exposed in the neck by opening the lower part of the posterior triangle. This is best done by making a curved incision (see Fig. 31) commencing at the posterior border of the sterno-mastoid muscle and running backwards and somewhat downwards to the margin of the trapezius, when it curves forwards again along the clavicle nearly to the sterno-clavicular articulation. The flap thus marked out is dissected up and turned forwards, the deep fascia opened and the omo-hyoid muscle exposed. In the upper part of the incision care must be taken not to injure the spinal accessory nerve as it runs back to the trapezius. The upper border of the omo-hyoid is defined and freed and the muscle is pulled well down, when the large trunks of the brachial plexus will be found lying immediately above it. These can be traced up to their respective points of exit from the spine, the damaged portions identified and suitable means already described for the repair of the injury undertaken (see Part II.). The flap is then laid down in position and sutured without a drainage tube.

Of injury to the cervical plexus.—The cervical plexus may be exposed by an incision running for about three inches along the posterior border of the sterno-mastoid, commencing immediately below the mastoid process; the lower part of the incision must be carefully deepened so as to avoid damaging the spinal accessory nerve. The lesser occipital nerve is readily seen as it winds round the posterior border of the sterno-mastoid and, by defining and tracing it back, the plexus can be easily exposed after separating the sterno-mastoid and pulling it well forwards. The cervical plexus scarcely ever requires exposure for injury; it may require it for persistent neuralgia.

RUPTURE OF THE STERNO-MASTOID MUSCLE.—Partial or entire rupture of this muscle is rare in adults but is not at all uncommon in newly born children in whom a swelling is found over the centre of the muscle which has all the characters of a hæmatoma and which is probably due to damage occurring during delivery, especially in cases of breech presentation. In other cases the swelling is undoubtedly of congenital syphilitic origin. The condition is mainly of importance because it is very apt to be followed by wry-neck (see p. 126).

Treatment.—If there be reason to suspect a syphilitic origin, the child should of course receive proper anti-syphilitic treatment; if not, the head should be fixed for two or three weeks in a suitable collar, and gentle friction should be applied to the swollen area after that period. The swelling usually subsides in about five or six weeks.

INFLAMMATORY AFFECTIONS OF THE NECK.

These are quite common. **Boils and carbuncles** are not infrequently met with on the back of the neck, particularly about the region of the collar where the neck is being constantly rubbed. Deeper seated suppurations are sometimes met with, and the very severe form known as Ludwig's angina (see p. 64) is not at all uncommon. **Suppuration in the cervical glands** is dealt with later (see p. 139).

Chronic abscesses in the neck are usually tuberculous and are practically always associated with enlargement of the lymphatic glands or spinal disease. These are referred to later (see p. 144).

Retro-pharyngeal abscesses, both acute and chronic, which are comparatively frequent and of considerable importance, have been fully described (see p. 79).

TUMOURS OF THE NECK.

New growths may occur in connection with various structures, such as the skin, muscles, glands, fasciæ or bones of the neck.

LIPOMA.—The neck is one of the commonest seats of lipoma and in this situation it is met with in two principal forms, either as the definite encapsuled variety or the diffuse lipoma.

The diffuse lipoma is particularly frequent in the neck and consists of large fatty masses on each side of the nape of the neck, beneath the chin or just above the clavicles; sometimes the entire neck may become affected. The condition steadily increases but rarely causes any trouble beyond the deformity, although we have met with a case in which the nerves were evidently affected, and the patient suffered considerable neuralgic pain.

Treatment.—Attempts are sometimes made to remove *the diffuse tumours* either on account of the pain or to remedy the deformity. The operation is however not one to be lightly undertaken as it is exceedingly difficult to dissect away all the newly-formed fat and there is a great tendency to recurrence unless this can be done. It is easy no doubt to distinguish between the newly-formed and the normal fat by the greater denseness of the former, which presents a gristly feel on incision; but the diffuse lipoma possesses no capsule and it is very difficult to make sure that all has been taken away. All this fat should be removed in all directions until the normal soft, semi-fluid fat is reached. The cutaneous nerves will no doubt have to be sacrificed. The operation is not likely to be followed by more than temporary benefit for the reasons we have mentioned and on the whole it is probably best not to interfere unless there be much pain. At the same time, if the patient be much annoyed by the disfigurement and begs for operation, it may be done, but he should be warned of the liability of recurrence. *The ordinary encapsuled variety of*

lipoma is treated as in other situations, and recurrence after the operation should not of course take place.

Various other tumours occur in the neck, such as fibroma, myxoma and sarcoma. Cysts are also met with and the most common, the branchiogenic cyst, has already been described (see p. 123). Enlarged bursæ about the hyoid bone are also met with (see Part V., p. 233). Cysts either of the thyroid or the accessory thyroid are fairly common; these are separately described (see Chap. X.). Blood cysts also occur, as do *air cysts*, which are merely diverticula from the pharynx in which the opening is too small to admit food but allows the entry of air, so that the pharyngeal pouch becomes distended and forms a tympanitic swelling in the neck which is easily emptied on pressure. The treatment is the same as for a pharnygeal diverticulum (see p. 66).

CYSTIC HYGROMA.—This is in reality a lymphangioma which is undergoing cystic degeneration and is practically always congenital. The tumour is a lobulated multilocular mass, often of great size and fluctuating in parts; there are usually a number of cysts which do not necessarily communicate. It is situated beneath the deep cervical fascia, sometimes in the submaxillary region, at others, in the lower end of the posterior triangle or sometimes in the interval between these. The lymphatic vessels in the vicinity are usually dilated.

Treatment.—This is very difficult. The treatment commonly recommended, namely, injection of the cysts with iodine, has little or no effect when the tumour is multilocular. On the other hand, incision into the lymphangiomatous mass often leads to an acute attack of inflammation which, if septic, may be fatal. Even with the greatest care, bacteria are apt to get into the wound and, although in the ordinary tissues they would do no harm, under these circumstances they may possibly develop and serious inflammation may result. Therefore, unless the tumour be increasing rapidly or be causing marked symptoms, it is well not to interfere, especially in very young children in whom restlessness might interfere with the proper maintenance of the dressings. If possible, the case should be left alone until the patient has grown up, when the tumour may be removed. In practising removal, care should be taken to carry the dissection well beyond the tumour in all directions if possible, so as not to leave any of the dilated lymphatics behind. No special rules can be given for the operations. They are often exceedingly tedious and difficult, as the mass spreads between the various important structures in the neck and the position of all of these has to be remembered in order that they may not be injured.

CHAPTER IX.

THE SURGICAL AFFECTIONS OF THE CERVICAL GLANDS.

These are among the most common and the most important affections of the neck and are various in nature. Thus tuberculosis, syphilis, secondary carcinomatous or sarcomatous disease or primary lymphadenoma or lympho-sarcoma of the glands may be met with.

ACUTE ADENITIS.

Acute adenitis is caused by irritation of the mucous or cutaneous surface drained by the glands and passes off when the irritation is at an end. Enlargement of the cervical glands in association with tonsillitis or other inflammations about the throat and mouth is extremely common, as it also is after irritation of the skin by boils, pediculi, etc., but, unless the inflammation be purulent or the patient be the subject of tuberculous disease, the mischief rapidly subsides. In neglected or very acute cases however suppuration may occur.

Suppuration.—When this is the case, the symptoms will vary according to the situation of the gland or glands affected and may be very acute. As a rule one or two glands only are implicated and the abscess is situated in the first instance in the interior of the gland capsule, but suppurative peri-adenitis soon occurs accompanied by very considerable induration of the surrounding tissues.

Treatment.—In the ordinary *acute non-suppurative adenitis* little need be done beyond relieving the pain by frequent hot fomentations, which should be surrounded with a large mass of hot cotton-wool which also serves the purpose of a splint and keeps the head and neck at rest. When the acuter stage has passed off, the application of glycerinum belladonnæ to the surface is sometimes useful. Should there be any delay in the disappearance of the swelling, gentle massage may be beneficial.

When suppuration occurs, the abscess must of course be opened. It is well to remember however that it is not advisable to cut into the

suppurating cervical glands on the first appearance of symptoms of suppuration. The pus in the early stages is often deeply seated in the gland, which is very considerably enlarged, or it may be outside the capsule, and the result of making an incision is to leave the gland still much enlarged and inflamed, and this takes a long time to subside. A much better plan is to apply fomentations in the first instance until the suppuration has occurred practically throughout the affected gland, as will be evidenced by free fluctuation; when this is the case, an incision shows that the gland is almost entirely destroyed leaving a cavity which heals rapidly. If an incision be made into a gland supposed to be the seat of suppurative adenitis and if only very little or no pus be found, the best plan is to proceed to enucleate the gland at once, either with a knife or a sharp spoon, so as to shorten the after-progress of the case. The wound will then heal rapidly and all the signs of inflammation will subside.

When opening abscesses in the anterior triangle care must be taken not to damage important structures, and it is here that Hilton's method (see Part I., p. 27) is particularly applicable; the parts are always so matted by inflammation that cutting into the abscess may be attended with very serious results. In operating upon women the incision should be made as small as possible and planned so as to be as inconspicuous as may be.

A condition of so-called "simple lymphoma," or persistent enlargement of glands after an inflammatory attack, has been described, but it is very doubtful whether it exists independently of tuberculous disease. The probability is that this is the essential nature of the condition, the tubercles however being few in number and not undergoing caseous degeneration.

TUBERCULOSIS OF THE CERVICAL GLANDS.

This is the commonest and most important affection of the cervical glands, and may occur in any of the glands, but is most common in the anterior triangle; the irritation producing the enlargement of the gland or the point of entrance of the tubercle bacilli is undoubtedly most frequently in the mouth or throat.

Pathology.—It is usual to assume that the adenitis follows the entrance of the tubercle bacilli into the glands and that in their turn the bacilli always come from a local source about the tonsil, throat, etc. We are of opinion that in many cases the adenitis precedes the tuberculous infection, and that the bacilli very often gain entrance from the blood. For example, an acute inflammation about the throat or mouth may lead to a cervical adenitis, which, not being infected with pyogenic organisms, does not go on to suppuration; as the primary irritation ceases, so the gland gets smaller; but in a susceptible patient in whom tubercle bacilli are present, the latter may be deposited in this inflamed, and therefore weakened, gland so that it

may again enlarge after a time and become a tuberculous gland. This is also probably the method of infection of the glands following sores on the head or those resulting from the irritation caused by pediculi, and is a simpler explanation than supposing that the bacilli enter from the skin.

The irritations which may give rise to enlargement of the glands are very various. Perhaps one of the most frequent is carious teeth and it has been presumed that the bacilli enter the tissues about the root of the tooth. Nevertheless, when the latter is removed the cavity heals completely and yet the glands remain enlarged,—a point in favour of the view just enunciated. Tuberculous glands in the neck also frequently follow enlargement of the tonsils, which in some cases are found to be tuberculous; in many however, even in phthisical patients, bacilli are not found in the enlarged tonsils, so that there is no definite proof that they gain access in this way.

Enlargement of the glands is more common in the anterior triangle than in the posterior or the submaxillary triangles. When the anterior triangle is affected, the enlargement rapidly spreads backwards beneath the sterno-mastoid and upwards and downwards along the course of the vessels.

Clinical characters.—There are great variations in the number and size of the glands affected, in the rapidity and progress of the disease and in the tendency to softening and abscess formation. From the point of view of treatment it is well to divide the cases met with into five large clinical groups:

1. The glands may remain small and hard and are not sufficiently large to produce deformity and have no marked tendency to softening. These glands are usually freely movable and there is no peri-adenitis causing matting of the glands to the surrounding tissues. Other glands slowly become involved but, unless some acute intercurrent mischief, such as sore-throat, occurs, they tend to get gradually smaller. After an acute attack of this kind however, sudden increase in size and suppuration may occur in one or more of the glands and the mischief may run an acute course.

2. In other cases the glands enlarge either steadily or by fits and starts until they attain a very large size and many glands are involved, so that marked deformity is produced. This condition is generally bilateral although it is often more extensive on one side and it may persist for a long time without suppuration, the glands remaining meanwhile more or less mobile and discrete. The disease tends to spread by direct continuity from the neck to the axilla. The patient usually is of a pasty complexion and the general health is poor. The glands on removal are generally found to be converted into large cheesy masses some of which show calcareous nodules. Some may appear quite normal to the naked eye, but under the microscope they always contain tubercles and tuberculous tissue.

3. In the third variety the disease is more acute and is prone to end in suppuration. The affection may be limited to a small group of glands but these enlarge very rapidly. Peri-adenitis sets in, and the glands are matted together and to the adjacent tissues; suppuration occurs early.

Abscess after abscess may form if the case be left alone, and numerous sinuses and unsightly ulcers often occur The sinuses may burrow in various directions, into the submaxillary triangle and down along the anterior and posterior triangles.

4. When the case first comes under notice there may be advanced suppuration in the glands but the abscess may not have burst externally. An abscess of this kind may either be beneath the deep fascia, in which case it is often fairly large and may occupy only a portion of the enlarged glandular mass or it may have perforated the fascia, forming a subcutaneous abscess with thin red skin over it. In other cases it may be more or less limited to one gland which may have broken down completely, so that there is practically only a bag of pus.

5. Finally cases are met with where an abscess has formed and has burst spontaneously or has been opened, and sinuses remain. These sinuses may be numerous or single. They lead down through a hole in the fascia to the remains of the glandular mass and at the bottom of the sinus there is generally a quantity of cheesy and often calcareous material and broken-down gland tissue that cannot escape. The skin around the orifice of the sinus becomes the seat of a tuberculous ulcer and ultimately there may be a large sore with undermined edges.

Treatment.—(a) Medical.—Medical treatment should be employed in all cases and in some it should be persevered in for a considerable time to the exclusion of surgical measures, whilst in others the question of operation in addition must arise at quite an early period. Plenty of country or seaside air, as much sunshine as possible and a nourishing diet combined with the administration of cod-liver oil are the chief points. Arsenic is very valuable in some cases and may be prescribed, when the patient can take it, in doses gradually increased from one minim up to ten or more according to the age of the child. The head should always be placed at rest as far as possible; various collars are sold for this purpose. In rapidly progressing cases it may even be advisable to mould a splint from the shoulders to the chin and occiput so as to check the lateral movements of the head. Local applications such as mercurial or potassium iodide ointments, tincture of iodine, etc., are always practically useless and may indeed be mischievous when the glands are superficial and are breaking down. In all cases very careful search must be made for any possible primary focus such as enlarged tonsils, carious teeth, sores about the head, ears, etc., and these should receive appropriate treatment at the outset.

The patient must be carefully watched, as in no case should medical treatment alone be persisted in when it is evident that suppuration is taking place. The sooner the glands are excised then the better, because delay only increases the difficulty of the operation owing to the matting of the tissues from the inflammation around. Patients should never be sent off into the country to come back in six or eight months' time; they should be seen at fairly frequent intervals such as a month, and operative measures

should be adopted on the earliest sign of suppuration. The following may be taken as the chief indications for operation:

1. When there is no diminution in the size of the glands after the lapse of two or three months under the most favourable conditions and under careful treatment on the above lines, and when there are large masses of glands giving rise to marked deformity.

2. When, in spite of the above measures, further glands are obviously becoming infected.

3. When the enlarged glands, which at the commencement of treatment were quite discrete and movable one upon the other, are becoming steadily matted together, and especially when the skin is becoming adherent to the glandular mass.

4. When signs of softening areas are evident in the enlarged mass; this indicates the onset of suppuration.

5. When sinuses are present.

(b) **Operative.**—The operative procedures may be either excision or scraping. The aim of excision is to remove along with the glands actually enlarged all those that may be possibly infected, and to do this so widely as to avoid recurrence. Therefore all the smaller glands in the vicinity of the enlarged mass should be removed and, even in comparatively limited cases, the operation to be effectual must be pretty extensive. Scraping on the other hand only affects the individual gland or glands that are breaking down, whilst others that are also affected are left untouched. It is no doubt true that the latter may subside when the original suppurating gland has been got rid of and that the disease may thus be cured; on the other hand, it is far more likely that they will rapidly enlarge and necessitate repeated operations. This method has its uses in certain cases, but it ranks far below excision in value. We shall consider the treatment appropriate to the five clinical classes already described in the first place and shall afterwards describe in detail the steps of the operation for removal of the glands.

1. When the glands remain small and hard, do not produce much deformity and betray no marked tendency to softening, the case may be watched for a time under appropriate medical treatment (*vide supra*) and, unless the disease becomes active, there is no need for operative interference. As long as the glands remain quiescent there is probably no great danger of dissemination of the disease and they may be left alone without fear.

2. When there is marked enlargement of the glands with considerable deformity or when the affected glands are numerous and the disease is extending, operation is generally required. When the disease has reached this stage, absorption is not the rule, and not only does the unsightly deformity remain but there is a tendency for the disease to spread and the ordinary medical measures seem to have little influence. Here the only possible operative procedure is excision; scraping would of course be utterly

futile as numerous glands are affected and it is quite impossible to remove the disease effectually with a spoon. Indeed the excision itself must be very free if it is to be of any use, and it may have to be repeated should the glands beyond the area of the first operation enlarge subsequently.

3. When the glandular trouble is very acute and rapidly goes on to adhesion of the skin and structures over it, it is very important that operative measures should be employed before any definite abscess has occurred if the best results are to be obtained. While these cases sometimes subside under careful treatment, the majority rapidly break down and fairly extensive suppuration occurs; hence they should be closely watched for this complication. It is very seldom here that only one gland is enlarged, and scraping is of little use as it only deals with the particular gland penetrated by the instrument. There are no doubt cases in which it may be possible to push the instrument from one gland to the other, but the result is very unsatisfactory as all the tuberculous material is not removed from the gland by the scraper, while smaller glands are left untouched and will often enlarge very rapidly after the irritation caused by the scraping of the glands in the neighbourhood. The result is that a sinus remains along the track of the scraper and causes considerable trouble. Hence we should strongly advise complete excision in these cases as in the previous ones; not, as has been advocated by some, merely excision of the main mass of glands accompanied by scraping of any portions adherent to the vessels, but clean and complete removal of the entire infected area.

4. When suppuration is occurring in the glands, the cases may be arbitrarily divided up into three groups: (*a*) The abscess, after bursting through the fascia, may form a comparatively limited swelling beneath the skin. In these cases complete excision of the gland and of the abscess may be performed in the manner described immediately, an oval piece of the skin being removed with the abscess. (*b*) The abscess in the gland may have burst through the fascia and have formed a large swelling beneath the skin, which is very markedly thinned over it. Here the operation sketched out above, namely complete removal of the abscess, gland and skin affected would entail a gap that it would be difficult to close and the scar of which would be very unsightly. It is therefore probably best merely to open the abscess in the first instance and three or four weeks later, when the skin has recovered and merely a sinus is left, to treat the case as one falling under the next heading of tuberculous glands accompanied by a sinus. In some cases where the mischief is extremely localised it may suffice for a cure to open the abscess and scrape out the gland. In most cases however a sinus is left and fresh glandular swelling appears and the case must be treated as above. (*c*) An abscess may be present which has not yet burst through the deep fascia. If the affection be limited to one or two glands only it may be feasible to wait and allow the abscess to increase in size until it is probable that the gland has become completely broken down, and then the abscess cavity may be opened and scraped, iodoform and glycerine

emulsion injected and the wound stitched up again. This of course is a very satisfactory operation from the point of view of scarring. When it can be done, a small incision behind the posterior margin of the sterno-mastoid will suffice, and the resulting scar is practically invisible. It is however only available in a very few cases, as it is useless when a large mass of glands is undergoing suppuration. In these cases a sinus will form and the glandular area will have to be excised.

5. When the enlarged glands are accompanied by sinuses, excision is undoubtedly the best method whenever it can be adopted, and it should always be carried out when there are not more than two or three sinuses along the line of the incision necessary for the operation upon the glands. When however there are numerous sinuses in different directions, this would involve a number of incisions and the removal of a considerable cutaneous area in order to completely extirpate the disease, and therefore thorough scraping of the sinuses and the glands at the bottom of them, followed by the application of undiluted carbolic acid to the raw surface, is the best treatment.



FIG. 35.—INCISIONS FOR REMOVAL OF TUBERCULOUS GLANDS FROM THE NECK. The incision along the anterior margin of the sterno-mastoid often suffices. The dotted line shows the extension of the incision that may be required to clear the sub-maxillary region at the same operation.

The method of operating upon tuberculous glands in the neck.—In operating for enlarged cervical glands the incision will vary according to the extent and situation of the disease and to other circumstances. The one we most commonly employ when the anterior triangle is chiefly affected commences over the anterior margin of the sterno-mastoid muscle about an inch below the lobule of the ear and runs downwards along the anterior

border to a point opposite the cricoid cartilage (see Fig. 35). In women or in cases where the disease is not very extensive the incision need not run quite so low. Another incision that is sometimes employed in similar circumstances, where it is important that the scar should be as little noticeable as possible, is a shorter curved incision which falls more into the natural folds of the neck, commencing a little lower and further back than the one just described, and curving downwards and forwards until it ends close to the larynx at or above the level of the middle of the thyroid cartilage (see Fig. 36). The elasticity of the skin allows of enough



FIG. 36.—OBLIQUE INCISION FOR THE REMOVAL OF TUBERCULOUS GLANDS IN THE NECK. This lies almost entirely along the natural folds of the neck, and the scar is hardly noticeable.

retraction to get good access to the glands. Should an abscess be present, the incision must be so planned as to include the thin skin over it.

When the glandular area requiring removal is very extensive, and both anterior and posterior triangles are involved, the incision suggested by Dr. Beatson of Glasgow (see Fig. 37) is very useful, and gives a scar that is hardly noticeable. This commences over the anterior triangle just in front of the sterno-mastoid muscle at a point opposite the angle of the jaw and runs backwards, curving down along the anterior margin of the trapezius until the lower part of the posterior triangle is reached, when it curves forwards again to the anterior edge of the sterno-mastoid just near the sterno-clavicular articulation. A large flap is thus turned forwards, and free access can be obtained to both the anterior and posterior triangles, whilst the scar is scarcely noticed from the front and the greater part

of it is readily concealed by the hair above and the collar of the dress below.

Before making the incision the most scrupulous purification of the region must be carried out, as septic infection in these operations would be disastrous. The hair is shaved from above the ear well back to the occipital protuberance when the glands are enlarged at all high up and a sterilised towel is wrapped around the head (see Part I., p. 109) so as to keep the hair well out of the way of the operator. The neck is extended over a sandbag and the head turned well over to the opposite side, and it is well to shut off the mouth by covering the side of the face on the affected side with a sterilised towel, in order to prevent possible contamination from saliva, etc.



FIG. 37.—BEATSON'S INCISION FOR TUBERCULOUS GLANDS IN THE NECK. It can be made to commence as high, or to terminate as low in the neck as may be wished.

After the skin and superficial fascia have been turned aside, whatever be the incision employed, the anterior edge of the sterno-mastoid is exposed throughout the whole length of the incision and the deep fascia is cleared from all the tissues in front of it but not opened. When the curved incision represented in Fig. 36 is employed it is well to detach the skin and fat below the wound for some distance and to pull the soft parts as far down as possible with a retractor.

The next step in the operation is to incise the deep fascia at the lower part of the wound close to the edge of the sterno-mastoid and to define the jugular vein. This is in fact the key to the operation, as the glands always lie close to the jugular and are often adherent to its sheath, and if attempts be made to remove them without previously defining the vein

great trouble may be experienced. The vein is therefore exposed well below the area of glandular enlargement and the sheath divided so that a blunt instrument and subsequently the finger can be insinuated between the vessel and the mass of glands, which is peeled off it in the upward direction. Should the vein be very adherent, as may be the case when the glands are much matted together and are suppurating, this procedure may be very difficult, as rupture of the tuberculous mass may readily occur; under these circumstances it is best to ligature the vein below in two places and divide it between. The upper end of the vessel can then be pulled upwards in one piece with the enlarged glands and separated easily from the artery and vagus nerve. The loss of the vein apparently makes no difference to the patient, whilst it is most important in facilitating the operation; it both renders it easier and minimises the risk of recurrence.

The further steps of the operation are practically identical with those already fully described in connection with removal of malignant glands from the same situation (see p. 53), viz. the exposure and ligature of the jugular vein as just described, separation of the tissues in front, with ligature of the veins passing back to the mass, exposure of the spinal accessory nerve, ligature of the jugular vein above, the careful and complete removal of all fat and glands above the spinal accessory nerve and beneath the upper part of the sterno-mastoid. As much as possible of the fat and glands beneath the muscle lower down should also be removed; indeed, a considerable portion of the posterior triangle can often be cleared out



Fig. 38.—Kocher's Forceps for the Removal of Glands. The gland is encircled by the ring of the forceps, while the prongs prevent the instrument from slipping.

through this incision if necessary. When the glands are more or less separate, deeply-seated and difficult to grasp properly in the fingers, the special gland forceps shown in Fig. 38 may be usefully employed.

It is well, after having cleared the tissues for some distance, to define the point of exit of the spinal accessory nerve from the sterno-mastoid as it runs across the posterior triangle to the trapezius muscle, and to preserve this from injury. In this way a quantity of glands and fat may be pulled out from the posterior triangle, and in the majority of cases a second incision along the posterior border of the sterno-mastoid can be avoided.

As has been already remarked in reference to removal of malignant glands in the neck, division of the upper end of the sterno-mastoid exposes the region much more thoroughly. This is not so necessary for tuber-

culous glands, but when the glands are very adherent it may help considerably.

It is well to bear in mind that the incision is very apt to divide a twig of the facial nerve which runs under the jaw and curves upwards to the angle of the mouth. If this be divided there is paralysis of a portion of the lower lip close to the angle. This can hardly be avoided, but in our experience it always disappears in the course of two or three months.

When the mass has been removed, a clean dissection of the anterior triangle and the parts underneath the sterno-mastoid muscle should be seen. In some cases glands are also present beneath the vessels, and in peeling off the vein it is well to try to take these along with it. If they do not come out thus they should be removed subsequently, and in any case this situation should always be looked to.

After the operation has been completed and the vessels tied, the incision is stitched up with a fine continuous silk suture, no drainage being employed. Sponges should be incorporated with the dressing so as to exercise pressure over the anterior triangle, and the dressing should not be changed for about ten days. If one proceeds in this methodical manner the chances of recurrence in the anterior triangle are extremely slight, as all the glands are removed. Recurrence may take place in the posterior triangle lower down, or anteriorly in the submaxillary triangle.

When sinuses are present.—These cases are usually septic and therefore it is well before beginning the dissection to scrape out the orifices of the sinuses, and then to sponge the surface with pure carbolic acid by pushing in a small piece of sponge soaked in the acid. The incisions are so planned that the openings of the sinuses are included between oval incisions, and care is taken not to open the sinus in the course of the operation; the best way to do this is to pass a probe along the sinus and keep it in position until the entire track has been defined. We have hardly ever seen infection of the wound occur in these operations; at the same time it is always well to put in a drainage tube for a few days in case infection should have occurred. When a drainage tube is employed, it is well to perforate the skin behind the sterno-mastoid muscle and bring out the end of the tube there, thus allowing the anterior incision to heal and securing drainage from the most dependent point.

When there are enlarged glands in both the anterior and posterior triangles they may be either removed from the anterior incision by extensive burrowing into the posterior triangle or a second incision may be made over the centre of the lower part of the posterior triangle, or still better, the incision recommended by Dr. Beatson (see Fig. 37) may be employed.

When the posterior triangle alone is the seat of the enlarged glands the main mass is usually just above the clavicle, and a flap may be

turned forward so as to obtain free acccss to the glands. The incision (see Fig. 39) commcnces at the posterior border of the sterno-mastoid above the level of the glands and sweeps backwards to the trapczius, then along the latter nearly to the clavicle, and then forwards to the sterno-mastoid again. A vertical incision over thc centrc of the glandular mass may be used when the glands are very numcrous and extend high up. The essential point in this operation is to avoid injury to the branch of the spinal accessory nerve which runs across the space to the lower part of the trapezius. This is very often difficult becausc the glands run along the nerve and may completely surround it.



Fig, 39.—Incision for the Removal of Enlarged Glands from the Posterior Triangle. The size of the flap will vary with that of the glandular mass to be removed.

The first part of the operation will consist in detaching the fascia from the posterior border of the sterno-mastoid muscle, paying special attention to the point of emergence of the spinal accessory. After having defined the nerve in front, a probe is insinuated along it and the tissues divided over the probe so that with a little care the nerve is bared throughout in its whole extent and may be kept from injury afterwards. The glands generally run beneath the sterno-mastoid muscle below, and are attached to the jugular vein; if the mass be pullcd upon, the jugular vein can generally be pulled out behind the sterno-mastoid. If this bc the case, the vein should be defined above the glandular mass, the sheath divided, and the glands detached backwards from it. On the right side this is very easily done; on the left side thc presence of the thoracic duct below must be remembered, and the fact that lymphatic branches run from the glands to the duct which may be torn across if too much violence be used.

When the glands are in the submaxillary region a curvcd incision from the symphysis of the lowcr jaw carried downwards to the hyoid bone and then backwards along it and upwards to the angle of the jaw (see Fig. 40) will cxpose the whole area. In many cases the glands are very adhcrent to the submaxillary gland, and while every effort should always be made

to leave this gland intact, it may be necessary to take it away in bad cases. There are no special points about this operation; the facial artery or vein may be cut, but are quite easily secured.



FIG. 40.—INCISION FOR REMOVAL OF ENLARGED GLANDS FROM THE SUBMAXILLARY REGION.

SYPHILITIC DISEASE OF THE CERVICAL GLANDS.

Affection of the cervical glands occasionally occurs in primary syphilis about the mouth or throat and is common in the secondary stage, the glandulæ concatenatæ being particularly prone to enlargement at this stage. Tertiary enlargements of the glands are sometimes met with, forming large masses which are very difficult to diagnose. The treatment of course is the treatment of the affection in general.

MALIGNANT DISEASE OF THE CERVICAL GLANDS.

This is common, and may be either secondary to similar disease on the mucous membrane or primary in the glands themselves. Of the primary disease, lymphadenoma is the common type, and has already been fully described (see Part I., p. 262). Among the secondary infections of glands may be mentioned those occurring in connection with malignant disease of the skin of the neck, the upper jaw, the mouth, the tongue, the pharynx, the larynx and the oesophagus.

Treatment.—With regard to the *secondary glandular affections* of the neck the treatment is, of course removal when the extent of the disease permits of it. This has been fully dealt with in connection with removal of glands secondary to malignant disease of the tongue (see p. 50).

With regard to the question of *lymphadenoma*, experience shows that operation is absolutely futile. Even when the glands affected are few and the removal is apparently extremely radical, it will be found that fresh glands enlarge almost before the wound has healed. On the other hand, some of these cases are so remarkably improved by the administration of arsenic that it is far better to put the patient upon this drug, commencing with doses of ♏v of Fowler's solution and gradually increasing it to ♏xv-xx, or more, intermitting it occasionally, and always interrupting the administration if any gastric derangement occurs. The subject has already been fully referred to (see Part I., p. 263).

CHAPTER X.

THE SURGICAL AFFECTIONS OF THE THYROID GLAND.

ATROPHY OF THE THYROID GLAND—MYXŒDEMA.

Atrophy of the thyroid gland is not uncommon, and gives rise to the disease known as myxœdema in adults. When the thyroid is absent in children the condition known as "cretinism" results. Operations which completely extirpate the thyroid gland also cause myxœdema in the course of time; that all cases of apparently complete extirpation of the thyroid gland are not followed by this affection probably depends upon the fact that some portion of the gland is left behind, as even a very small portion remaining is sufficient to prevent the occurrence of this condition.

The symptoms and treatment of this affection do not properly belong to a surgical work; they are dealt with fully in medical text-books, and one of these should be consulted.

INFLAMMATORY AFFECTIONS OF THE THYROID GLAND.

ACUTE THYROIDITIS.—This may be suppurative or non-suppurative and its causes are apparently various. Thus, injury, exposure to cold, rheumatism and various septic conditions are often associated with it. The gland enlarges, the skin over it is red, tender and œdematous, and there may be considerable interference with swallowing. The patient's general condition is one of considerable gravity, the constitutional symptoms being severe out of all proportion to the extent of the inflammation. The probability is that this is due in some way to interference with the secretion of the gland. The affection may end in resolution, or a localised or a diffuse suppuration throughout the gland may occur.

SUPPURATIVE THYROIDITIS.—This sometimes occurs in a previously existing cyst as a result of puncture or drainage, or it may occur in a cyst which has not been so treated, and, should this be situated deep in the thyroid, the difficulty of diagnosis is great and the patient's

condition may be serious. Thrombosis and pyæmia are not uncommon sequelæ of an acute suppurative thyroiditis, and this is not surprising when the extreme vascularity of the gland, particularly its richness in large veins, is considered.

Treatment.—In the first instance a purge (calomel gr. v.-x.) should be given, and this should be followed by the administration of remedies directed against the cause. Thus, in rheumatic patients the administration of salicylate of soda (grs. x. three times a day) is called for; in malarial cases, those due to typhoid fever or those occurring in connection with septic processes, the administration of quinine (in 5-grain doses every four hours) may also be useful.

Locally, four to eight leeches should be applied over the enlarged gland, and these should be followed by hot fomentations to promote the bleeding. Large hot fomentations are the best means of relieving the pain and easing the difficulty in swallowing. When the affection is subsiding, the whole thyroid area should be smeared with glycerinum belladonnæ.

When suppuration occurs, as will be indicated by marked and increasing œdema of the skin, combined with a high temperature and an area of softening, an early incision should be made for the evacuation of the pus. Great care must be taken however in practising this, as the large venous trunks may be wounded by too free use of the knife. The best plan is to open the abscess by Hilton's method (see Part I., p. 27), making the skin incision as small as is consistent with efficient drainage, and planning it so that it lies in the natural folds of the neck to avoid subsequent deformity.

The other inflammatory affections of the thyroid gland hardly require notice, as they are excessively rare. **Tuberculosis,** which may either be part of a general infection or a localised deposit, may occur in the thyroid gland as elsewhere, and the treatment must be as for tuberculous disease in general. **Syphilis** of the thyroid also occurs in the form of a gummatous infiltration of the gland in the tertiary stage. This is of great interest from the point of view of diagnosis, but its treatment offers no points of special importance. It should be that of tertiary syphilis elsewhere.

GOITRE.

Under this term it is usual to include almost all enlargements of the thyroid not of an inflammatory nature. Goître is often divided up into several classes, such as simple or parenchymatous, exophthalmic, adenomatous, cystic and malignant goître. As a matter of fact the pathological condition present differs very widely in the different cases.

SIMPLE OR PARENCHYMATOUS GOITRE.—There is here a general enlargement of the thyroid gland involving both its secreting and fibrous structures. The affection may be limited to one lobe or to the isthmus, or it may uniformly affect the entire gland. In the majority o

cases the entire gland is involved, although the enlargement may be more marked on one side or in the isthmus.

It may happen that the increase in the secreting structure is much in excess of that in the fibrous stroma and these cases are sometimes called **colloid goîtres**. On the other hand, the fibrous tissue may be in excess, when the tumour is harder and smaller than in the former case and is often termed a **fibrous goître**.

Pathology.—Goître is endemic in certain regions. In England it is commonest in Derbyshire, where it is known as "Derbyshire neck." It is very common indeed in Switzerland. It is not as a rule hereditary, and nothing definite is known as to its causes. At one time it was assigned to the presence of salts of magnesium, calcium, etc., in drinking water. It has also been attributed to the want of iodine in the water, whilst by others it has been thought to be due to a lack of sunshine, to dwelling in the cold, and to the drinking of snow-water. The bacterial origin of goître has also been put forward, and an attempt has been made to uphold it by pointing out that drinking water containing an excess of magnesium and other earthy salts, but very pure as regards bacterial contents, has not affected those who consumed it, whilst waters in the neighbourhood, containing less saline constituents but highly contaminated with bacteria, have been followed by the development of goître in large numbers of people; nothing certain however is yet known about the causation of the disease.

Symptoms.—The enlarged gland gives rise to a characteristic swelling in the lower part of the neck which moves with the trachea on deglutition and which takes the outline of the portion of the thyroid gland affected. If one lobe only be affected, respiration is as a rule not interfered with, although the weight of a very large tumour may seriously interfere with comfort when the patient lies on the back. In other cases again the enlargement may chiefly affect the posterior part of one lateral lobe and may thus press on the œsophagus and may find its way between it and the trachea, causing much discomfort. Here too the recurrent laryngeal nerve may be compressed and abductor laryngeal paralysis may result. The principal trouble however is met with when the disease is bilateral. If the enlargement be considerable, the two lobes exert lateral compression upon the trachea, which sometimes reaches such an extent as to almost occlude it. This lateral compression produces what is known as the "scabbard trachea." In some rarer cases the enlargement may be most marked in the lower part of the gland and may get down behind the sternum and may thus compress the trachea between this structure and the spine. Here the pressure is in the antero-posterior direction and is usually exerted by a cyst, and there is often marked interference with deglutition and pressure upon the recurrent laryngeal nerve. Long-continued pressure upon the trachea is prone to cause atrophy of the tracheal rings, and this is a most important point to bear in mind during

operation, as very slight force might suffice to open the trachea—an accident of extreme gravity, partly because of the likelihood of blood finding its way into the air-passages in fatal quantity, partly because it is then impossible to keep the wound in the neck aseptic. The amount and nature of the dyspnœa produced in these cases varies very considerably, and careful distinction should always be drawn between the dyspnœa due to the pressure upon the recurrent laryngeal nerve—in which case there will be marked aphonia—and that due to compression of the trachea—when there will be stridor both on inspiration and expiration, but no aphonia.

Treatment.—This may be either non-operative or operative, and the choice between the two will depend largely upon the presence or absence of severe pressure symptoms. Formerly it was the custom to place dependence mainly upon non-operative measures, some of which are no doubt valuable while others are distinctly dangerous. It is only recently that operative measures have come at all largely into general use.

(a) **Medicinal.**—Chief amongst the *internal remedies* are iodine and iodide of potassium, and distinct improvement is said to have followed moderate doses of the latter drug, which should be commenced in 3-grain doses three times a day, and need seldom be increased beyond 10 or 15. Other internal remedies are not very satisfactory. In very anæmic patients arsenic and iron may be of some value, but as a rule they have not much influence upon the affection. Recently thyroid extract has been administered on the presumption that it would insure physiological rest to the gland. Benefit has been claimed from this, but we cannot say that we have been able to convince ourselves that it is of any use, and in no case apparently does it cause disappearance of the goître.

Various methods of *local treatment* are in use. In India the red iodide of mercury ointment is rubbed in thoroughly over the goître, and the neck is then exposed for some hours to the rays of a hot sun; it is stated that very great improvement has been obtained in this way but unfortunately in this country the method is quite useless and is not worth while attempting. Other irritants, such as iodine, iodide of potassium, etc., have been applied to the skin but without marked benefit. Lastly, injections of iodine or iodoform have been made into these parenchymatous goîtres and good results have been obtained; but we are unable to recommend the method, as the injection of as small a quantity as 10-15 drops of tincture of iodine is usually followed by very considerable reaction with swelling of the gland, pain spreading up to the jaw, and, unless great care be taken, by suppurative thyroiditis. There is also a very considerable risk of injecting these substances straight into the circulatory system. As an injection, one part of iodoform, five of ether and five of olive oil, has been employed much in the same way, the injection being repeated every three or four days and from 3 to 15 minims being introduced at a time. Considerable diminu-

tion is said to have resulted from this. The ether no doubt produces a certain amount of necrosis and, if external sepsis be prevented, it is possible that this may gradually reduce the size of the gland. We look upon these measures however merely as placebos rather than as useful methods of treatment and, considering the great safety with which operations can now be carried out, we doubt whether they are worth pursuing energetically. Either the condition is not serious enough to call for active treatment or surgical intervention offers the only certainty of doing any real good.

It may happen either that the patient refuses to submit to the operation of thyroidectomy or that for some reason an operation of this magnitude is contra-indicated, and tracheotomy may be called for to relieve the increasing dyspnœa. The operation here may be excessively difficult, as the trachea is flattened, usually laterally, until it is not thicker than an ordinary rib and it may be extremely difficult to find and open it. Moreover the administration of the anæsthetic under these circumstances is one of the very gravest difficulty. An ordinary tracheotomy tube is of course no use because it will not reach below the constriction, and a long, flexible tube (see Fig. 41) must be employed and gradually insinuated beyond the obstruction. When the compression of the trachea is lateral, the tube should also be flattened somewhat laterally. It is very useful also to be provided with several black olivary catheters of sizes ranging from No. 10 to 16 or 18, as it may be necessary to relieve the asphyxia in a hurry and the catheter can often be got past the obstruction more quickly than the tube, which is substituted for it when the asphyxial symptoms have been relieved.



FIG. 41.—LONG FLEXIBLE TRACHEOTOMY TUBE.

(b) **Operative.**—The only reliable method of cure is to remove the portion of the gland that is causing the chief trouble. In the early days of operation upon the thyroid the entire gland was removed, but it was soon found that many of the patients so operated upon suffered from a peculiar disease which was subsequently recognised as surgical myxœdema and which was evidently due to too complete removal of the gland. It was then found that all that was necessary to prevent this occurrence was to leave a portion of the gland behind. As a matter of experience, it is found that, even though only a comparatively small portion of the thyroid be removed, great benefit results. By removing for instance a portion that is compressing the trachea, as for example the isthmus, the pressure symptoms disappear and the thyroid left behind often gradually diminishes in size. This is especially important when there is a retro-sternal enlargement or where both lobes are affected and compress the trachea laterally. It is well always to leave behind one lobe, and the operation should be limited to the removal of one lobe and the isthmus. If this be done there is no danger of myxœdema and,

while the operation gets rid of the pressure on the trachea, it is practically almost certain that there will be atrophy of the portion remaining, so that no deformity remains.

The dangers of the operation mainly consist in those attaching to the administration of the anæsthetic. A certain amount of risk no doubt is run from *free bleeding* or from *the entry of air into the veins*, but these dangers should really never occur if the operation be properly performed. The bleeding is practically a negligible quantity if the operation be done methodically, following the steps of the description given below. Formerly no doubt very furious and even fatal hæmorrhage was common and it is to the fear caused by this that such a very imperfect operation as simple division of the thyroid isthmus is to be ascribed.

The anæsthetic question is very important and it is most important that the administrator should be a skilled anæsthetist. Although personally we have not lost a patient from the anæsthetic, in cases of simple goître, yet deaths have occurred not infrequently and cases are constantly met with that give rise to grave anxiety. Many surgeons, especially abroad, have now given up the use of general anæsthesia entirely and perform the operation under some local anæsthetic such as Schleich's cocaine infiltration method. It is a remarkable feature about these operations that they are not accompanied by any considerable amount of pain. Apart from the skin incision, little pain occurs at any stage of the operation except at the moment of "dislocating" the enlarged gland; so that it is actually possible to perform the operation without any anæsthetic except some cocaine anæsthesia for the skin incision and without causing a great amount of pain. This is the experience of so eminent an authority as Kocher. It is urged as a great advantage of local anæsthesia that the safety of the recurrent laryngeal can be ascertained from time to time by making the patient talk. For our own part, we have always employed a general anæsthetic, but we are quite of opinion that, in any case of goître causing severe stenosis, local anæsthesia, especially Schleich's infiltration method, may be of value when the patient is very nervous or a skilled anæsthetist is not available.

Thyroidectomy.—The operation must be performed with the most scrupulous antiseptic precautions, as, if suppuration occurs in the large wound left by the removal of the goître, the most serious consequences are likely to ensue; the pus burrows into the mediastinum, and septic thrombosis followed by fatal pyæmia is very liable to occur as the portion of gland left is very vascular. If sufficient care be taken to do the operation aseptically, all danger should be at an end when the operation is complete.

Incisions.—Various incisions have been recommended from time to time by various writers, and no doubt different incisions will have to be made according to the particular conditions met with. At one time it was very common to employ a median vertical incision extending from the upper border of the thyroid cartilage down to the sternal notch, and this incision has more recently been slightly modified by making it angular by carrying it to

one side above. Another very favourite incision is along the anterior border of the sterno-mastoid (see Fig. 43). All these have objections. A vertical median incision does not give satisfactory access, and if, in order to gain this, the incision be made oblique above, the scar left is unsatisfactory as the vertical scar contracts after healing and leaves a rigid band which may interfere with the movement of the larynx and is certainly unsightly. On this account we have entirely given up its use. The oblique incision along the sterno-mastoid is also unsatisfactory except in special cases. Unless the tumour be quite small it does not give really good access to the thyroid either above or below. The sterno-hyoid and sterno-thyroid muscles will commonly require division in order to give sufficient exposure of the tumour and this, even though the muscles be carefully stitched together afterwards, is very apt to lead to an unsightly hollow on that side of the neck after healing. At the same time for small cysts or adenomata situated high up in the outer part of the lobe it may be employed.

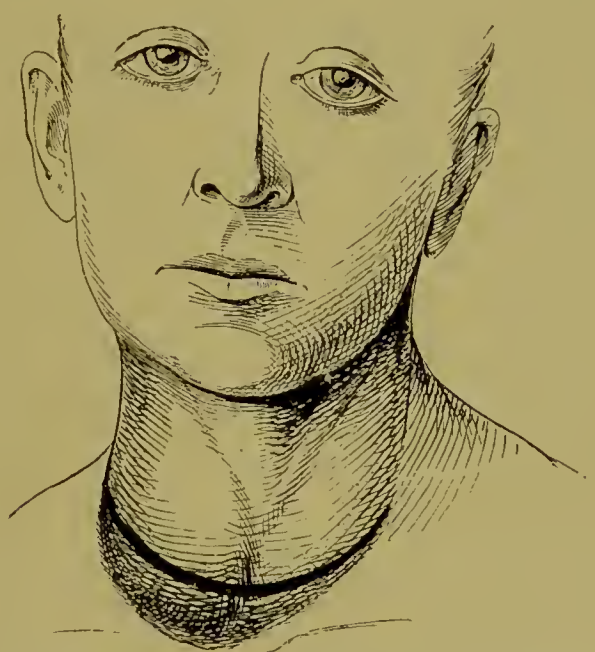


Fig. 42.—Kocher's Thyroidectomy Incision. The exact position of the incision will vary with the nature of the case. The end of the incision on the side of the lobe that is to be removed should be carried up higher than its fellow.

On the other hand the transverse incision associated with the name of Kocher is entirely satisfactory. This incision (see Fig. 42) is a slightly curved one with its convexity downwards and commences over the centre of the sterno-mastoid muscle on one side in the neighbourhood of the upper pole of the swelling and runs across the neck with a slight convexity downwards to a corresponding point on the opposite side. The terminations of the incision are carried upwards to an extent varying with the amount of retraction of the soft parts that is likely to be necessary for proper exposure of the upper part of the swelling. In the less marked cases the incision may

be almost transverse. This incision not only gives a perfect view of the whole region but it falls into the line of the natural folds of the neck when sutured, and, if carefully stitched with a fine suture, gives the most extraordinarily unnoticeable scar. Even when the enlargement of one lateral lobe runs unduly high up towards the hyoid bone the most perfect access can be gained by prolonging the horn of the incision upwards on that side.

If possible the patient should have the anæsthetic administered in the semi-recumbent position with a sandbag beneath the neck so as to throw the head well back and render the tumour prominent. If however this position should cause embarrassment to respiration, the anæsthetic must be administered in the position of greatest ease, and in this the patient must remain at any rate during the earlier stages of the operation. The anæsthetic administered should generally be chloroform, as ether causes marked venous engorgement and unduly free bleeding; moreover the irritation of the ether is more likely to embarrass the respiration. The anæsthetic should be administered with extreme care and very slowly, and any nervousness on the part of the patient must be overcome by correspondingly cautious administration. The head should be wrapped up in an aseptic towel to keep the hair out of the way (see Part I., p. 109), and then, the parts having been thoroughly purified (see Part I., p. 161), the incision described above is carried across from one sterno-mastoid to the other, its extremity being higher up on the side from which the lobe is to be removed. The lowest point of the convexity should reach rather below the centre of the swelling, that is to say, about an inch above the sternum. In this incision the platysma and deep fascia are divided throughout and the fibres of the sterno-mastoid are seen at each end of the wound, whilst the muscles running from the larynx to the sternum are exposed in the centre. The superficial structures are now dissected up for some little distance, the upper flap being raised as far as the upper border of the tumour, and meanwhile care must be taken not to puncture the anterior jugular vein lest air be drawn into it; if it must be divided, it should be seized in forceps beforehand. The upper flap should be well retracted by an assistant, or if there be a scarcity of assistants, a stitch may be passed through it and fastened beneath the chin. The superficial structures below the incision are also freed in a similar manner as far down as the lower limit of the growth. This of course is not an actual flap, but the freeing of the parts allows them to be well pulled down or stitched out of the way. During all this time great care is taken not to exert any pressure upon the tumour or the larynx so as to avoid interference with the breathing, and no attempt should be made at this stage to isolate the tumour.

The next point is to divide the deep cervical fascia in the middle line over the isthmus of the thyroid until the true capsule of the growth is exposed. If this be done strictly in the middle line little or no bleed-

ing will occur. Care must be taken only to carry the incision down to the capsule of the gland and not through the latter, as otherwise the bleeding may be embarrassing. The finger is now slipped in beneath the deep cervical fascia and swept over the gland beneath the laryngeal muscles and one can, with a very little aid from the knife, readily peel the fascia and muscles off the lobe of the thyroid and expose it freely. Any veins divided should be immediately clamped. The laryngeal muscles should be raised from the isthmus on both sides of the middle line; on the side on which the lobe is to be left they need not be further detached, on the side however from which the lobe is to be removed the muscles are as a rule very much spread out and they should be raised by peeling them well forwards and outwards, and, if the size of the tumour allows it, they should be turned off the latter without division. Should the swelling be very large, however, it may be necessary to divide them and turn the ends out of the way, suturing them together subsequently at the end of the operation. At this stage there is practically no bleeding, only a few bands of fascia requiring division and a few small veins clamping. The clearing of the lobe to be removed should be continued with the finger until its upper limit is reached and the finger is swept well around its upper pole. It is at this point that the superior thyroid vessels are met with and they require to be secured before proceeding further.

The division of the superior thyroid vessels and the accompanying "dislocation" of the enlarged lobe marks the most critical period of the operation. Up to this point there should have been absolutely no violent disturbance of the relation of parts, as the separation of the structures superficial to the gland above described can be quite easily carried out by a single finger swept around, and this does not in any way add to the patient's difficulty in respiration. The next stage however does so, luckily only for a few moments. It is well to warn the anæsthetist at this point so that he may either administer less anæsthetic or stop it entirely if he thinks fit, resuming it after the danger is over. When the finger has swept round the upper portion of the lobe so as to free it, the superior thyroid artery can often be felt pulsating; if it be not felt, it can be seen as a whitish band by hooking the forefinger well around the upper part of the lobe, pulling it forcibly forward and at the same time having the sterno-mastoid fully retracted. Two pairs of clamp forceps are put upon the vessels and these take up both artery and veins running in a band of fascia and this is divided with scissors. The dislocation of the enlarged lobe now commences and should be carried out as rapidly as possible on account of the interference with the breathing. The finger is passed round behind the lateral lobe and is swept all over it, freeing first its upper part which is pulled forcibly forwards and inwards. As the finger proceeds to free the lobe behind, this structure is pulled more and more inwards until in a very short time the enlarged

gland shoots out of its bed in the neck, is extruded through the wound and the further procedures are carried out in the open. As soon as this has happened all lateral pressure is taken off the trachea and all real danger from anæsthetic accidents should be over.

When the gland has been extruded through the wound, the next step is to proceed with the separation of the fascia from its posterior surface. This is steadily stripped down until the extreme lower end of the tumour is reached, near which the inferior thyroid vessels are met with. These do not enter at the lowest point of the lobe in one or two single trunks, as is the case with the superior thyroids, but break up into a number of branches scattered over the lower part of the posterior surface. As a rule, if the dislocated lobe be pulled forcibly forwards, these come well into view, can be easily isolated, clamped together in one mass, and divided; this step of the operation requires care, however, and should be done in a good light and with careful sponging, in order to avoid all chance of the recurrent laryngeal nerve being included in the clamp. The veins, often of large size, running downwards from the lower edge of the lobe must also be clamped and divided.

Nothing is now necessary but to free the gland from the trachea and to remove the required portion. If the isolation of the lobe be carried out strictly as recommended here, by peeling off the structures from the posterior surface quite close to the capsule of the gland from above downwards, it is quite easy to make absolutely certain that neither the œsophagus nor the recurrent laryngeal come to any harm. With the upper part of the lobe, of course, the recurrent laryngeal has no connection of any sort, and if everything be cleared steadily backwards and downwards from it towards the œsophagus, the nerve must go with the structures peeled off. As the detachment proceeds, the tumour is pulled steadily inwards to the middle line and is separated from the trachea. Here the operator must be cautious, as, if the pressure be great and have lasted for some time, softening of the rings may have occurred, and damage is easily done. In any case of doubt the simplest and best plan is to sink the blunt dissector with which the separation is being accomplished into the gland tissue so as to leave a little attached to the trachea instead of peeling it off quite cleanly. The whole lateral lobe is thus readily raised from the trachea until the isthmus is reached, and then, according to the necessities of the case, the surgeon may either remove the lobe from the isthmus or may carry his separation a little further, raising the isthmus from the trachea, and finally removing one lobe and the isthmus together, and leaving the opposite lobe behind. In descriptions of this operation it is usual to find instructions given for the passage of a series of ligatures between the isthmus and the lobe in order to stop bleeding when the two are separated. We ourselves have never found this in the slightest degree necessary as there is a distinct line of demarcation by fibrous septa between the isthmus and the lobes. The vessels in the isthmus itself are comparatively small, and two or three clamps will suffice to pick up bleeding

points. We have contented ourselves as a rule with either tearing through the isthmus or the tissues on one side of it, and have never had any trouble with the bleeding.

If the operation be done strictly in this manner it is quite simple, and the bleeding is hardly noticeable; in fact, it is scarcely necessary to use more than a single sponge during the operation. Provided that the capsule be left unopened and everything peeled off it, the thin-walled veins ramifying on the surface of the gland are not injured, and the profuse bleeding, formerly so common in these operations, is entirely avoided. An additional point of the greatest importance is that much time is saved.

We may recapitulate the keys to the operation in the following order: First, the separation of the fascia, leaving the front of the capsule of the thyroid clean, clamping and division of the superior thyroid vessels, clamping and division of the inferior thyroid vessels and of the veins leaving the lower border of the lobe, detachment of the recurrent larnygeal with gradual separation of the tumour from the trachea, and, finally, tearing through the isthmus.

As soon as the tumour has been removed, sponges are packed into the large cavity left, the various vessels clamped are tied with catgut, and the wound is carefully inspected for bleeding points, all of which are seized and tied. It is well not to trust to twisting in these cases, as oozing may subsequently occur into the cavity, and is very unpleasant. In all, about a dozen ligatures will usually be called for. We are always in the habit of introducing a drainage tube for two or three days. Although at the time of the operation the bleeding may be stopped absolutely, there is always considerable oozing afterwards into the large cavity in the neck which it is impossible to obliterate by sponge pressure, and this blood clots and may cause interference with union or even pressure upon the trachea. We always insert the tube in the following way. The superficial structures detached below the wound are held up, and a small button-hole is made through them just above the sternal notch of sufficient size to introduce a drainage tube of moderate size (No. 14). A tube is pulled in through this, and its end should lie in the tissues beneath the sterno-mastoid in the lower part of the cavity, from which the lobe of the thyroid has been enucleated. The transverse wound is then sutured accurately with a very fine continuous buttonhole silk suture. Through the edges of the small drainage tube incision a suture is passed, its ends left long and knotted, so that it can be tied subsequently when the tube is removed.

Difficulties during the operation.—These, as we have already said, should be very trifling if the precautions we have indicated be properly taken. It may however happen that, when the trachea is seriously compressed, the asphyxial symptoms become alarming; of course if this be noticed in time, the anæsthetic should be stopped and the further stages of the operation, at any rate up to the dislocation of the gland, should be performed without one, the patient being in the meanwhile allowed to regain a proper colour and to breathe naturally before any further manipulations

are attempted. Sometimes, however, stopping the operation in this way does not suffice to ameliorate the symptoms, and under those circumstances it may be necessary to perform tracheotomy. This however should be looked upon as one of the most serious accidents that can happen in these operations, as not only is the tracheotomy itself extremely difficult under those circumstances owing to the distortion and narrowing of the trachea which often extends down behind the sternum, but even more serious than this is the fact that it is then impossible to keep the wound in the neck aseptic. The surgeon and the anæsthetist must therefore be constantly on the watch to avoid this untoward accident. In view of the fact that a tracheotomy may be necessary, the surgeon should always be provided with an extra long flexible tracheotomy tube (see Fig. 41), which may be bent to any required shape, and should always have in addition several large catheters, which may be used to pass down through the tracheotomy opening so as to get beyond the constricted portion. The ordinary tracheotomy tube is hardly ever efficient if there be much lateral compression of the trachea, as its end will not reach down sufficiently far. If a tracheotomy be done, great precautions must also be taken during the operation to prevent blood passing down the trachea, and an assistant should be told off especially to perform this duty.

Should there be by any chance serious bleeding from the raw surface left when the lobe and the isthmus are detached, and should it be impossible to seize the vessel satisfactorily in forceps, it is quite a simple matter to under-run the bleeding point either with an ordinary fully curved needle threaded with silk or with a sharp nævus or aneurysm needle. In our experience however this is really never called for.

After-treatment.—After the ordinary gauze dressings have been applied and a large mass of wool put on to act as a splint around the neck and fastened with bandages carried beneath the shoulders as well as around the neck and head to prevent shifting of the dressing, the patient is put back to bed lying flat upon the back, with a small pillow beneath the head so as to tilt it slightly forward and relieve all tension upon the line of incision. The head should be steadied by a sandbag on either side. The dressing need not be changed for three or four days unless there be very free oozing from the tube. At the first dressing the drainage tube may be left out and the temporary stitch tied so as to obliterate the hole. Recovery is usually extremely rapid and the relief from the removal of the thyroid is marked and immediate, so that the patient begins to breathe normally before the operation is completed.

Cases sometimes occur which are marked by distinct and peculiar symptoms of so-called "*thyroidism*" after this operation. These are mainly high temperature without any signs of local inflammation, and a rapid pulse (about 120) which is sometimes irregular. There is also a feeling of suffocation and restlessness and there may be slight delirium; in some cases death has occurred without any further symptoms. It is presumed

that these symptoms are produced by the absorption of the thyroid secretion poured out into the cellular tissue from the raw surface made by detachment of the enlarged portion of the gland. We ourselves in a very large number of cases have not been troubled by this condition, which we attribute largely to the fact that all our wounds are drained and that the thyroid material can therefore escape without becoming absorbed. Should the condition arise, free drainage must be employed, and it has been suggested to wash out the wound. Morphine may be given for the restlessness and arsenic has also been tried.

THYROID ADENOMATA AND CYSTS.—In our experience these form the great majority of thyroid enlargements in this country. It is comparatively seldom that a diffuse parenchymatous goitre is met with in London either in hospital or private practice; whether this be also the case abroad we cannot say.

In this condition the gland as a whole is unaffected; but small nodules of thyroid tissue take on independent growth forming typical adenomata surrounded by a capsule. The adenomata are usually multiple, and may grow to an excessive size, giving rise to great enlargement of some particular portion of the gland which may cause serious inconvenience to the patient. Other simple tumours are stated to occur in the thyroid gland, but they are very rare.

Cysts of the thyroid are also very common, and they are definitely encapsuled and usually multiple. As a matter of fact the cystic condition is usually a cystic transformation of previously existing adenomata, so that we may speak of thyroid adenomata as being in some cases solid, in others cystic. When the cyst has reached a large size there is practically no remains of the original adenomatous tissue.

Echinococcus cysts are also met with in the thyroid. In the early stages the symptoms are very like those of an ordinary cyst, but if punctured, of course, the contents are characteristic of this affection. Cases have been known where the cyst has ruptured into the trachea and caused a fatal result. We need not describe these further as the symptoms and treatment are practically those of the ordinary cystic adenoma.

Treatment.—This is entirely surgical, and the operations for the removal of cysts and adenomata are identical and quite simple. The incision employed should be the same as before (see p. 160), and is followed by detachment of the laryngeal muscles performed as described above. This exposes the gland containing the tumour which as a rule is prominent and has very little true thyroid tissue intervening between it and the capsule. The best plan, whether the tumour be a cyst or an adenoma, is to make a free incision through the thyroid capsule over the tumour until the true capsule of the latter is reached, and then, with a blunt dissector aided by the finger, the adenoma or cyst is shelled out of its bed. The swelling, with its capsule intact, should be taken out whole and, as soon as a little separation of the anterior portion has been effected with the instrument, the finger

passed in and swept round will generally detach the rest easily. There is as a rule little bleeding, a few vessels at the bottom of the cavity from which the tumour has been removed being all that require clamping. These swellings are often multiple, so that, after having removed one, the rest of the gland should be carefully examined for others, which if present are enucleated by boring down to their capsule through the thyroid tissue from the cavity left after removal of the first tumour ; the finger is swept round them and they are turned out. There is no need to make

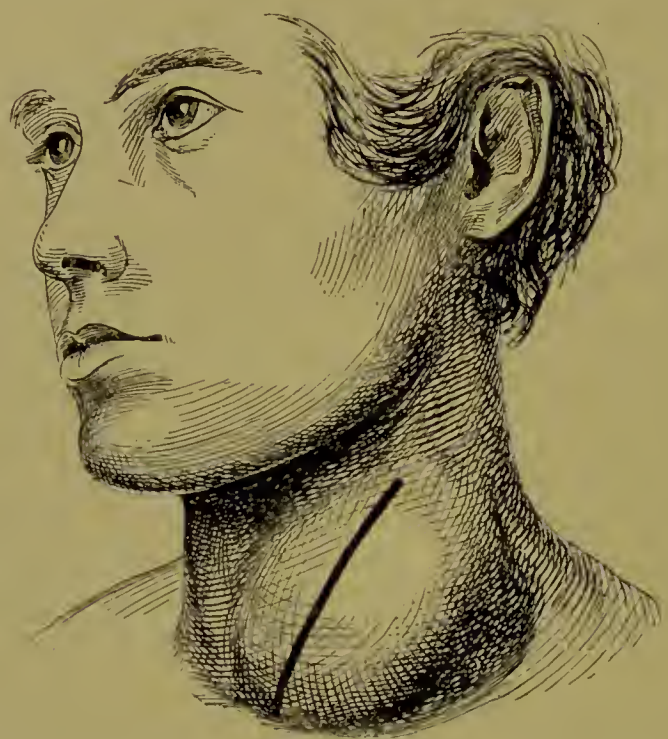


FIG. 43.—OBLIQUE LATERAL INCISION FOR THYROID TUMOURS. This corresponds to the anterior margin of the sterno-mastoid and is only of use for a small tumour situated well to one side.

a fresh incision through the capsule, as the bleeding when boring through the gland is very slight. In this way a large number of adenomata may be shelled out without the necessity for removing any of the true gland substance.

The only difficulty met with is in cases of long-standing cysts in which the walls are calcareous and firmly adherent to the gland in which they lie, and this difficulty is considerably increased when the cyst has been punctured or injected and inflammation has been set up around it. Under these circumstances it may be necessary to remove the entire lobe in which the swelling lies and the operation will then be a true thyroidectomy (see p. 158). We have however very rarely indeed found it necessary to do this. Should it be necessary, particular care must be taken to preserve the recurrent laryngeal from danger, as cysts which have been repeatedly tapped or injected may contract very firm and extensive adhesions.

The *after-treatment* is the same as for thyroidectomy. A drainage tube should be introduced either in the same way or, if the tumour be small, directly through the wound over the seat of enucleation.

Enucleation performed as above is really the only possible way of dealing with solid adenomata. The cystic form, however, may sometimes be tapped and injected with iodine or some other irritant material, but we do not advise this except when the patient refuses an operation or, for some reason, operation is not considered desirable. Tapping should be done with the most careful antiseptic precautions because suppuration in a thyroid cyst is apt to give rise to very serious symptoms not only from the septic condition itself but from the consequent œdema and swelling of the thyroid and the increased pressure upon the trachea. As an injection, 5-15 minims of tincture of iodine may be introduced after the contents of the cyst have been evacuated. The results of tapping and injection are however by no means as satisfactory as they sometimes are in the case of an ordinary serous cyst, as the cyst is here merely a part of a tumour. Often the only effect of the injection is to cause the cyst to become adherent to the gland and thus to seriously increase the difficulty of removal afterwards. The cysts have also been opened and drained with some partial benefit, but here again, unless great care be taken, suppuration is apt to occur and very serious symptoms may follow. Besides this, the progress of the case is tedious in the extreme, while the operation for enucleation is so simple and safe that incision and drainage are hardly justifiable.

MALIGNANT GOITRE.—The usual form of malignant disease of the thyroid is carcinoma, which follows the usual course of the disease elsewhere, destroying the organ in which it is growing, infecting the neighbouring glands and spreading to other parts of the body. The disease generally is rapidly fatal, six months being about the average duration of life from the time that the trouble is discovered. This rapidity is partly due to the pressure on the trachea producing gradually increasing dyspnœa, partly also to the great general weakness which follows the destruction of the gland and which is doubtless to some extent due to the loss of thyroid secretion.

Symptoms.—The symptoms to which this condition gives rise are marked pains of a lancinating character, with rapid infiltration of the trachea and compression of the œsophagus, accompanied by difficulty in swallowing and severe dyspnœa. The tumour shows itself as a densely hard growth which is comparatively small. A point on which some stress is laid as serving to distinguish these tumours from simple enlargements is that in the latter the vessels are pushed outwards and may be found even as far out as the posterior triangle, while malignant tumours surround these structures and do not materially displace them.

Sarcoma of the thyroid has also been described and is usually of the round-celled variety. There is not the same infiltration of the whole gland as in carcinoma, but rather a very rapidly growing tumour situated in one lobe. The diagnosis will probably not be made until after removal. The extreme

rapidity of the growth however might cause a suspicion as to its true nature.

Treatment.—Attempts have been made to remove a carcinoma of the thyroid by operation but these practically always end in failure. The gland is widely infiltrated with the disease, and the whole mass soon becomes firmly adherent to the surrounding structures, particularly the trachea and the œsophagus and, in attempting to detach it, either of these structures may be opened, or portions of the disease may be left behind, so that no attempt at operative interference should be made unless the case be in a very early stage and be limited to one lobe of the gland.

Palliative treatment will of course be called for, as the difficulty in breathing must be relieved, and therefore tracheotomy should be done before the operation becomes too difficult, and a long tracheotomy tube (see Fig. 41) should be introduced.

EXOPHTHALMIC GOITRE.—This is essentially a medical affection and comes under the care of the physician, but, as attempts have been made of late to employ surgical treatment in these cases, it may be well to refer to it here.

Symptoms.—Exophthalmic goitre has a very definite train of symptoms consisting essentially in palpitations, tachycardia or irregular heart rhythm, considerable anæmia, fibrillar tremors of the muscles, most marked in the upper extremity and the tongue, protrusion of the eye-balls accompanied by the symptom known as Von Graefe's sign, namely a lagging behind of the upper eyelid when the patient looks down, so that the sclerotic is visible between the lid and the cornea, together with more or less marked enlargement of the thyroid accompanied by actual pulsation, thrills and bruits about the root of the neck. The affection generally occurs in women between the ages of 20 and 40 and may be associated with uterine or ovarian irregularity. It often comes on after overwork, worry or severe mental shock, and is occasionally met with in men.

The progress of the case varies in different subjects. In the majority it becomes steadily worse until a fatal result occurs from general weakness, syncope or some cardiac affection. In a small minority the disease becomes arrested either spontaneously or under treatment.

Pathology.—The pathology of the disease is quite unknown. By some it is supposed to be due to a derangement of the sympathetic nervous system especially in the cervical region. By others it is attributed to an excess of the thyroid secretion, whilst by others again it is considered to be a central nervous lesion.

Treatment.—**(a) Medicinal.**—In the first place the patient should be placed under the care of a physician and treated medicinally. Freedom from overwork, worry and anxiety should be secured if possible and any uterine or ovarian disorder should be corrected. The patient should also be placed among as cheerful surroundings as possible and change of air, especially a sea voyage, is very useful. Many drugs have been

employed for the affection. If the patient be anæmic, arsenic is especially indicated, whilst for sleeplessness or excitement bromide of potassium is valuable. Digitalis and other cardiac tonics may be necessary when the heart symptoms are marked. Thyroid extract has been administered but does not appear to have been followed by any special benefit; indeed some cases seem to get worse under it. Better results are stated to have followed the use of extract of thymus gland.

(b) **Surgical.**—*Thyroidectomy.*—Should medical remedies prove unavailing, surgical measures, which have come considerably into prominence of late years, should be tried.

On the view that the disease depends upon excessive thyroid secretion, removal of a portion of the thyroid gland has been practised in a large number of cases, the portion removed being usually the lobe that is most enlarged and which is therefore most likely to interfere to some extent with breathing; in some cases the isthmus alone has been removed. The result thus produced is sometimes extremely remarkable; according to several reliable observers a considerable proportion of the cases have been entirely cured; at any rate the tremors disappear, and some estimate that the proportion of cures is as high as 40% of those operated upon. We ourselves have done a considerable number of these cases and although, in only one instance can we say that we have obtained an absolute and permanent cure, the improvement has often been very remarkable, the nervous phenomena, such as the tremors, palpitations and tachycardia, being especially benefited. Patients who are unable to enjoy any amusement or to do any mental or even fine manual work are often able to do so after the operation. We cannot however say that as a rule we have seen the exophthalmos disappear or even the nervous phenomena get entirely well.

The operation is not unaccompanied by danger. Although the thyroid gland pulsates and bruits are heard over it, we have never found any difficulty whatever with regard to hæmorrhage. If the operation be performed as we have already described (see Thyroidectomy, p. 158) the bleeding is practically nil and, as there are no adhesions to the neighbouring structures, the gland can be turned out readily and quickly. The great danger is however the anæsthetic, and a number of patients have died whilst under its influence. We ourselves have met with two instances in our own practice; so that the operation, if decided upon, must either be performed under cocaine or the very greatest care must be observed in the administration of the anæsthetic. In spite of this, however, we are decidedly of opinion that, should the medical treatment fail, it is well worth the patient's while to have the most prominent portion of the thyroid removed.

Division and removal of the cervical sympathetic.—Another method of treatment that has come into vogue of recent years is based upon the theory that the cause of the disease lies essentially in the cervical sympathetic, and attempts have been made to cure it by operation directed to this structure. Thus the cervical sympathetic trunk has been divided in the

neck, or the superior cervical ganglia have been removed and considerable improvement is said to have followed this. If the superior cervical ganglion alone is to be removed it is best reached through an incision about three inches in length along the anterior border of the sterno-mastoid muscle and with its centre just below the angle of the jaw. The anterior margin of the muscle is defined and hooked well back, the deep cervical fascia is divided and the carotid sheath exposed and pulled well in towards the middle line, when the ganglion is readily seen behind it and can be removed. We have described elsewhere[1] the points of importance in the operation. It should be performed on both sides.

Quite recently Jonnesco of Bucharest has removed the entire cervical sympathetic chain on both sides including all three ganglia and their connecting cords, and claims the most excellent results for the operation. We have no personal experience of these procedures. When the entire cervical chain is removed it is better to make an incision along the posterior margin of the sterno-mastoid and displace the muscle forwards, defining and pulling inwards the carotid sheath. The sympathetic chain is found behind this, and the superior or middle ganglion is identified and the rest of the cord and the ganglia followed and removed. On no account should either of these operations be attempted by separating the carotid artery and the jugular vein as there is sure to be much bleeding and the vagus may be damaged.

Other surgical measures such as ligature of the thyroid vessels have been tried but seem to possess no advantages whatever over the removal of a portion of the gland.

[1] *British Medical Journal*, 1900, vol. ii., p. 1175.

DIVISION III.

THE SURGICAL AFFECTIONS OF THE ABDOMEN.

CHAPTER XI.

AFFECTIONS OF THE ABDOMINAL WALL.

TRAUMATIC AFFECTIONS OF THE ABDOMINAL WALL.

Injuries of the abdominal wall, like those occurring elsewhere, may or may not be accompanied by a breach of the skin; that is to say, they may be divided into wounds or contusions. The actual affections of the abdominal walls themselves differ in no way from similar injuries elsewhere, but their importance is due to the fact that they are often associated with injuries to the abdominal cavity or its contents. Thus, an incised wound may penetrate the abdomen and damage its contents, and even a severe contusion may be associated with the most extensive internal injuries. When the abdominal wall is forcibly struck, the muscles involuntarily contract and, up to a certain point, protect the abdominal contents. When, however, the blow is severe, the wall yields to the pressure, especially when the blow is sudden and the muscles are taken by surprise, and deeper-seated injuries occur. These are very various in their nature and may be rupture of the stomach, intestines, bladder, liver, spleen, kidneys, etc. In considering injuries of the abdominal wall therefore we have to deal with two great classes: 1. Injuries limited to the abdominal wall itself, which in their turn may be (*a*) simple contusions, (*b*) rupture of muscles, and (*c*) various forms of non-penetrating wounds; and 2. Injuries accompanied by lesions of the abdominal contents; these again may be grouped under two headings, (*a*) those in which the skin is unbroken, and (*b*) those accompanied by a penetrating wound of the abdominal wall.

INJURIES LIMITED TO THE ABDOMINAL WALL.

SIMPLE CONTUSIONS.—These are comparatively rare, for the abdominal wall usually gives way before a sudden blow and so escapes

much bruising; in fact, when a bad contusion of the abdominal wall is met with, the probability is that there is also injury to the abdominal contents and this constitutes the great importance of these cases. Locally the signs of contusion are the same as elsewhere, namely effusion of blood, tearing of the deeper tissues, etc.; the only important point to be considered is whether the injury is associated with rupture of the abdominal muscles (*vide infra*). When contusion of the skin of the abdomen occurs without injury to the contents it means that sufficient contraction of the muscles has occurred to prevent the force being transmitted to the abdominal viscera.

Treatment.—The patient should be put to bed at once and a firm bandage outside a mass of cotton wool should be applied around the trunk so as to give the abdominal muscles rest and support. The shock must be suitably treated by stimulants, hot blankets, and so forth. The hæmatoma that forms should be treated as a hæmatoma elsewhere, and if large the most rapid and satisfactory method is to incise and drain it. Hæmatomata in this situation, especially when situated towards the posterior part of the abdomen, are more likely to suppurate than are hæmatomata in other parts, probably because there is bruising of the whole thickness of the abdominal wall and the large intestine beneath and bacteria may pass directly from the interior of the latter into the contused tissues. The patient must be kept quiet and watched very carefully for the appearance of symptoms of peritonitis. This might arise either from some unsuspected injury to the abdominal contents or from deep-seated suppuration in a hæmatoma involving the peritoneum.

RUPTURE OF MUSCLES.—This may occur either from external violence or spontaneously from sudden contraction of the muscle itself. The latter condition of course does not strictly come under the definition of an injury to the abdominal wall, but it is more convenient to refer to it here.

When a muscle is ruptured as the result of external violence, the muscle affected is usually the rectus, although more rarely some of the lateral abdominal muscles may be torn. The rupture may be partial or complete, but in the great majority of cases only a few fibres are involved.

The injury is usually marked by sudden and severe pain at the time of the accident, accompanied by some degree of shock. Vomiting is not uncommon although it is not always present, and the pain is naturally increased by vomiting and by pressure. In bad cases there may be a certain amount of temporary paralysis of the intestine accompanying the injury, but this is more usual where the effects of the force have been transmitted to the abdominal contents. In the course of a few hours a hæmatoma may form and this will considerably obscure the nature of the injury. As the blood becomes absorbed, the defect in the muscle may be evident to touch, and the thickened ends may be felt above and below, while there may be a bulging forwards of the abdominal wall in the interval. When the abdominal viscera are not injured, the patient pro-

gresses satisfactorily, but the pain on throwing the abdominal muscles into action may last for some time, and, when only a few fibres are affected, the pain may last for a very long time, and is then probably due to adhesions of fibres to one another or to other muscles. Ventral hernia not infrequently follows at a later period.

The spontaneous rupture of a muscle not uncommonly follows a sudden movement of a patient who is the subject of a debilitating disease and in whom the muscles have undergone a certain amount of waxy degeneration. This is perhaps most common in typhoid fever, and those convalescing from this affection may rupture the recti quite easily when attempting to sit up, or when vomiting, coughing, etc. Rupture of perfectly healthy abdominal muscles also may occur in violent gymnastic exercises, playing tennis, or in any exertion accompanied by a sudden twist of the trunk; the rupture usually only involves a small portion or even a few fibres of muscle, but it may give rise to considerable and persistent pain.

The symptoms of spontaneous rupture are much the same as those of rupture due to traumatism. There is great pain at the time, inability to perform certain movements and often vomiting, constipation and sometimes serious collapse which often leads to suspicion of a strangulated internal hernia or commencing peritonitis. Ecchymosis follows the rupture, and pain may persist for some time.

When a muscle is spontaneously ruptured in a healthy subject, healing occurs readily even though the ends may not be in perfect apposition. When however the rupture involves only a few fibres, a painful spot is very likely to be left for a considerable time, probably due to adhesion of the muscular fibres preventing the free action of the muscle. When however rupture occurs in those convalescing from typhoid fever or other debilitating diseases, repair is much slower and it is sometimes complicated with suppuration; in the end however it occurs fairly satisfactorily.

Treatment.—*When the rupture only involves a few fibres* the best treatment is to put the patient at rest for a few days; if there be any swelling, an ice-bag may be applied for the first 24 hours. After that, gentle rubbing with some slightly stimulant liniment, such as lin. terebinth. aceticum, should be employed to promote the absorption of the effusion. This is followed, if pain continues, by vigorous massage so as to free any adhesions between the muscular planes. Rest should not be continued for more than a week from the commencement of treatment as otherwise pain and stiffness may persist.

When a muscle is extensively ruptured, the parts must be put at rest in such a position as to enable the torn ends to come close together; for example, when the rectus is affected, the shoulders and pelvis should be raised. When this suffices to secure approximation this position should be maintained for two or three weeks, when extension may be gradually effected; spontaneous movements of the muscle may be allowed after six weeks. When however there is wide separation of the ruptured ends

and when it is impossible to bring them together satisfactorily, a better result will be obtained by exposing the torn ends, turning out blood-clot and suturing the ruptured muscle; this has the additional advantage that it enables measures to be taken against the possible occurrence of a ventral hernia subsequently. When a muscle is completely torn across, the ruptured ends are apt to curl up, so that the smooth outer surfaces of the muscle are opposed, and these unite very imperfectly. The method of suture has been already described (see Part II., p. 199).

When the rupture occurs in the course of a disease, such as typhoid fever, the muscular fibres have degenerated, and, quite apart from the fact that the patient is not then in a condition to stand an operation, the chances of proper healing after suture are comparatively slight. Another argument against operation is the fact that in these cases the ends of the degenerated muscle do not tend to curl up as do those of a healthy one. We should therefore not suggest operation here.

NON-PENETRATING ABDOMINAL WOUNDS.—These may be inflicted with sharp instruments, such as a knife or a bayonet, by bullets or by blunt instruments, in which case the wounds are contused. The important question in all cases of a wound of the abdominal wall is whether it penetrates the peritoneal cavity, and whether, if penetrating, it is accompanied by injury of the abdominal viscera. We are only dealing here with the non-penetrating wounds; the other form is dealt with later. In non-penetrating wounds of the abdominal wall there is usually comparatively little shock or bleeding, although the latter point varies of course with the position and nature of the injury. Unless the wound becomes infected and suppuration occurs the patient does perfectly well.

Treatment.—The first and most important point to determine is whether the wound is penetrating, and this should be ascertained in every case of a wound of the abdominal wall. Before proceeding to make a full examination it is most important to disinfect the external wound and the skin around as thoroughly as possible so as to avoid carrying infective material to the deeper parts of the wound, or possibly into the peritoneal cavity, upon the fingers, instruments, or sponges; for it must be remembered that, even when there is actual penetration, the instrument by which it was caused may not have carried infective material further than the surface, especially if the wound be small.

The disinfection of the wound is effected as already described (see Part I., p. 161) taking particular care to prevent the strong disinfectant from running into the abdominal cavity should the wound be a penetrating one. Instead of passing a probe to see if there be a penetration of the abdomen, the wound should be enlarged so as to expose the opening in the muscles at any rate, and then the deeper parts should be disinfected before going further. The condition of the parts deeper than the muscles may finally be investigated. If no opening be found, a small gauze drain should be put in at one end of the wound and the muscles and skin carefully

sutured in layers. It is well to pass a stitch through the muscles opposite the point at which the drain emerges and to knot its ends and leave it long so that it can be tied subsequently when it is certain that the wound is aseptic and that drainage may safely be discontinued; this is important as, if a drain be left in longer then two or three days, a ventral hernia is extremely likely to occur through the small opening left by it in the abdominal wall.

When the wound divides muscles transversely to their fibres, the skin wound must be thoroughly opened up and, after dealing suitably with the deeper part of the wound, the muscles should be carefully stitched together as already described (see Part II., p. 161). If it be necessary to employ a drain deeper than the muscles in these cases, it is best to make it emerge by separating the muscular fibres longitudinally, and bringing the end of the drain out between the separated fibres. This will enable the transversely divided fibres to unite accurately, whereas the emergence of the drain between them might interfere with it. A stitch should be passed through the muscle opposite the drain in the manner just described (*vide supra*), and tied at the end of two or three days when the wound is aseptic and the drain is removed.

INJURIES COMPLICATED BY DAMAGE TO THE ABDOMINAL CONTENTS.

ABDOMINAL CONTUSIONS ACCOMPANIED BY VISCERAL INJURIES.—A point of the greatest importance and difficulty is to determine whether in any given case the abdominal wall alone be injured or whether the internal organs have suffered also. This point is most difficult to make out immediately after the injury, but it must nevertheless be decided as soon as possible, for rupture of one of the internal organs is not at all uncommon after a severe blow on the abdomen, and in many cases the only chance of successful interference is at the earliest possible moment. The viscera usually injured are the small intestines; the colon lies deeply in the loin and the stomach high up under the ribs, and both are very likely to escape damage unless distended; should the latter organ be distended, as after a meal, it is on the other hand very liable to injury. Fixation of the intestines, either normal or pathological, renders them more liable to rupture than the freely movable portions; for instance, the duodenum is not uncommonly ruptured from a blow over the upper part of the abdomen, whilst the rest of the small intestine slips out of the way and escapes. Similarly, old inflammatory adhesions which fix the intestines either to one another or to the abdominal wall, render them very susceptible to damage. Besides the intestines, the mesentery or the omentum may be damaged, and fatal hæmorrhage into the peritoneal cavity may occur. The other abdominal organs, such as the liver, the spleen, the kidney, etc., may also be ruptured.

The undeniably grave prognosis of an injury to the abdominal organs depends on the fact that, on the one hand, extravasation of their contents may occur and may lead to a rapidly fatal septic peritonitis or, on the other hand,

there may be directly fatal hæmorrhage. In either case it is evident that early recognition of the true nature of the case affords the only real chance for the patient. It is exceedingly rare for patients to recover from severe injuries of this nature without operation.

Unfortunately, as we have said, it is often extremely difficult to be certain of the diagnosis in the early stages, and it is not until some time has elapsed that the symptoms are sufficiently unequivocal to lead to an accurate estimation of the state of affairs. Amongst the more important points tending to confirm the diagnosis of visceral injury are prolongation of the shock, intense and continued pain, and persistent vomiting. At the same time, should there be gas free in the abdominal cavity, as shown by diminution in the liver dulness. combined with distension of the abdomen, the diagnosis is fairly certain, This condition however is not common in the early stages, and the only sure sign is the development of definite symptoms of peritonitis. Unfortunately, when this stage is reached it is generally too late to do good by operation, and it is far better to open the abdomen on suspicion than to waste valuable time waiting for the onset of a peritonitis that puts the case beyond help. Unless the patient be extremely feeble, the exploratory laparotomy is not likely to be accompanied by much danger, unless followed by free manipulation of the abdominal contents; as a rule this is not called for, as the seat of injury is immediately beneath the site of the contusion.

When the intestines have been ruptured, the condition rapidly becomes more grave; the dyspnœa becomes more intense, there is marked distension of the abdomen, the patient assumes the typical abdominal aspect, and death occurs very rapidly. When other abdominal viscera have been ruptured, the symptoms special to the particular injury, which will be dealt with in their appropriate place, set in. Sometimes, when the bowel has been injured and no extravasation of its contents has occurred, a localised peritonitis may be set up which prevents infection of the general peritoneal cavity should perforation occur at a later date; the result is a limited abscess in the peritoneal cavity after the evacuation of which a fæcal fistula results.

Treatment.—When the immediate symptoms are not urgent, and the diagnosis of an internal injury is therefore not clear, it may be justifiable to wait for a time and to employ the ordinary remedies for shock (see Part I., p. 139) until the patient recovers slightly. The question of the administration of morphine in the treatment of pain and shock is somewhat difficult because, though it tends to mask the symptoms, it is undoubtedly beneficial in immobilising the intestines, and thus diminishing intra-peritoneal extravasation should rupture have taken place. Therefore, unless the pain be very severe, it is well to avoid its use, but when pain is excessive a small dose (gr. $\frac{1}{6}$ hypodermically) may be given. The patient should be kept absolutely at rest in bed upon the back, with the knees flexed and tied together over a pillow, and nothing should be given by the mouth. If the phenomena of shock disappear in a few hours and no further peritoneal symptoms arise it may be presumed that no serious internal injury has been done.

On the other hand, if the initial symptoms, especially severe collapse with a small rapid pulse and subnormal temperature, continue or if persistent vomiting sets in or there be increase of the pain and a tendency to distension, it is well to open the abdomen without delay. This is still more imperative when hæmatemesis, immediate meteorism, obliteration of the liver dulness or localised tympanites is present; here the best plan is to open the abdomen at once by an incision close to the middle line unless there be some marked local injury to one side. If for instance there has been a severe blow over the liver, the gall bladder, or the spleen, rupture of one of these structures may be suspected, and it is then perhaps better to make the incision over the seat of injury.

Exploratory laparotomy for abdominal contusions.—In all these operations special attention must be paid to the diminution of shock. This question has already been dealt with (see Part I., p. 139); in the cases under notice the greatest reliance will be placed upon the hypodermic administration of strychnine and performing the operation in a well-heated room (70°-75° F.) with all the rapidity possible.

Shock plays such an important part in all injuries to the abdominal viscera that the importance of the various measures to combat it cannot be over-estimated. The patient's extremities should be wrapped up in cotton-wool or thick woollen stockings, and surrounded by blankets and hot-water bottles; if possible, the operating table should be a hot-water table (see Part I., p. 140); all abdominal cloths,[1] towels and lotions should be hot, and the normal saline solution[2] used after the abdominal cavity is opened must be carefully kept at or above the body temperature. The solution used for the surgeon's hands and for the sponges should be frequently renewed to keep up its temperature, whilst that used for irrigating the abdomen should be strictly tested with a thermometer. Large quantities of the solution must be at hand, as quarts or even gallons may be required during the operation and there must be no delay in making it.

The anæsthetic should be ether or the A.C.E. mixture, and before

[1] The ordinary abdominal cloths are made of linen and are 12 to 18 inches square, with hemmed edges. They are prepared for use by boiling for at least 15 minutes either in normal saline solution (.75%) or plain water. After being boiled, they are put to drain in a hot-water jacketed vessel so that they remain always hot, and their number is carefully counted before and after operation. If smaller cloths than these be used it is a very useful precaution to have a long piece of silk or tape fastened to one corner of each cloth. This is allowed to hang out of the wound and may be grasped in forceps. There is then no risk of overlooking a very small cloth as may readily be done when working deep in the abdomen. These cloths are superior to gauze or sponges as they are absolutely unirritating.

[2] As this solution will be referred to frequently in the later chapters it may be well to state its composition here. It is a .75% solution of common salt, and is made by adding 1 dram of common salt to the pint of water, boiling this for 15 minutes in a covered vessel and allowing it to cool to the required temperature—as ascertained by the thermometer.

operation a hypodermic injection of strychnine (m\v.) may be given, to be followed by another if necessary during its progress. It is well if possible to administer a hot enema containing two ounces of beef tea and an ounce of brandy about a quarter of an hour before the patient goes upon the operating table, and instruments should be at hand for the purpose of intra-venous saline infusion, which may be practised before operation if the shock be very extreme. As a rule the rectal enema is sufficient unless there be severe hæmorrhage also. It should however be had recourse to during the operation if the shock be very severe.

It must never be forgotten that not only is the operation accompanied by severe shock in itself but the patient before the commencement of the operation is profoundly collapsed, and it is of the highest importance to have everything ready before the anæsthetic is commenced. We also advise that the shaving and purification of the abdomen, arrangement of towels, etc., should be done at this stage in order to shorten the length of the anæsthesia. The preliminary injection of morphine (*vide supra*) will greatly diminish the pain that this would otherwise cause. The bladder must be emptied by a catheter.

The first point after the abdomen has been opened is to inspect the interior by simply separating the edges of the abdominal incision without disturbing the parts. The whole question of the treatment of the abdominal wall, as apart from its contents, is treated separately (see p. 185).

The first thing that meets the surgeon's eye on opening the peritoneum may be extravasated blood, and the point is then to investigate its source. Some help may be gained by noticing its distribution or by seeing whether it wells up from any particular region as it is sponged away. Large vascular organs, such as the liver and the spleen, are very commonly the seat of serious hæmorrhage, and these should be examined first unless the seat of the hæmorrhage be obvious; if wounded, they should receive appropriate treatment which will be dealt with later. Should the bleeding not be from either of these sources, it is probably from the omentum or the mesentery, and these should be examined methodically in this order and any bleeding point secured. Numerous hot abdominal cloths will be required to receive and cover the intestinal coils as they are brought out of the wound.

If there has been much hæmorrhage into the peritoneal cavity, blood will gush out as soon as the peritoneum is divided to an extent that may give the surgeon the impression that it is actively pouring out of some big vessel; as a matter of fact, it will be the blood that has accumulated in the peritoneal cavity, as can be seen by the fact that it is mixed with quantities of clot. Till this has to some extent been got rid of it is practically impossible to ascertain the source of the hæmorrhage, and, therefore, the wound should be held wide open, and the sides of the abdomen gently pressed together with the view of squeezing out the blood as quickly as possible. The remainder may then be mopped up from the

surface, and an attempt made to ascertain by sight from what direction the bleeding comes.

If on inspection intestinal contents be found in the abdomen, some clue as to the site of the extravasation may be obtained by examination of the extravasated material; thus, if it be a sour-smelling fluid containing undigested food without any fæcal odour, the condition of the stomach should be investigated first; if the food be partially digested but devoid of intestinal odour, it is suggestive of injury to the duodenum, which should receive attention first; if the material be distinctly fæcal, the small intestine or the large must be examined first according to the characteristics present; the contents of the small intestine will be liquid and usually yellowish in colour, whilst those of the large bowel are semi-solid or contain hard masses and are dark brown or black. These points should always be noted before any disturbance of the viscera is carried out.

The surgeon is undoubtedly often saved a tedious search, and the prospects of the patient are proportionately improved by the fact that in many cases the seat of injury lies immediately beneath the abdominal incision, especially if this be made over the seat of the blow. Any injury severe enough to damage the intestine generally arrests the peristaltic action at once, so that the injured bowel lies in the position that it occupied at the time of the injury. When found, any wound of the stomach or intestine must be repaired in the most appropriate manner; this is dealt with later. Sometimes the intestine is not only ruptured but is so severely bruised as to render its recovery impossible and it will then be necessary to excise the injured portion; the method of doing this is considered later.

When on opening the abdomen neither blood nor intestinal contents are found extravasated on the surface, it is well to investigate the condition of the intestines before closing the wound because, although peristaltic action is generally arrested when the bowel is injured, the damaged portion may possibly have become displaced and covered in by healthy coils. The search must be made methodically, and in the following manner. The first step is to raise the omentum so as to expose the intestines, for the omentum may prevent fæcal material, or hæmorrhage from the mesentery, coming into view at once; the intestines should next be gently pressed back from the abdominal wall, so as to allow the escape of any extravasated material from either side. If neither blood, nor intestinal contents, nor gas be thus found, the probabilities of a severe intestinal lesion are, of course, very much diminished; at the same time it is not advisable to close the abdomen without further inspection, because, on the one hand, a rupture of the intestine may be so small that the orifice is temporarily plugged by prolapsed mucous membrane, and will nevertheless, if left untreated, cause infection of the peritoneum, or on the other, the mesentery may be so bruised and its vessels so injured that subsequent gangrene of the intestine may occur.

Hence, when no injury is discoverable, it is well to review the coils of the intestine methodically, so as to make sure of its condition, and this can be done without allowing the escape of the intestinal coils from the abdomen. First of all the small intestine should be inspected in the following manner: the incision is covered with hot abdominal cloths (see p. 177), leaving only sufficient room for inspection of the coils, and the assistant takes care that no further protrusion occurs. The surgeon then slips his hand in towards the cæcum, and, grasping the extreme lower end of the ileum at that spot, he inspects the entire small intestine, passing it coil by coil through his fingers, and packing each loop away towards the right side of the abdominal cavity as it is examined. In this way the whole of the small intestine can be rapidly passed under review, and any injury, either to it or to its mesentery, will be evident at once. The transverse colon can also readily be examined, and if that also be found intact the abdomen may be closed in the usual manner. If there be much shock it is well to fill up the abdomen with salt solution, which has the double advantage of being absorbed much in the same way as a rectal enema and of keeping the intestines mobile during the closure of the wound.

When the intestinal contents have been extravasated, the important question arises, before closing the wound, as to whether the abdomen should be washed out. This matter will be more appropriately considered in connection with penetrating wounds of the stomach (see Chap. XIII.).

PENETRATING ABDOMINAL WOUNDS. — When the instrument that produces the injury penetrates into the abdominal cavity, it may or may not inflict injury upon the abdominal contents. When there is no such injury, serious trouble may nevertheless result from immediate prolapse of portions of the viscera through the opening, or a ventral hernia may follow healing. If there be injury to some of the abdominal viscera this may be very similar to the injuries produced by contusions of the abdomen (see p. 175). As in those cases, it is of the highest importance to ascertain at the earliest possible moment whether such damage has occurred or not; here, however, we do not wait in any case. The wound is at once opened up and the abdominal contents examined in the manner already described (see p. 177).

The symptoms are much the same as those of non-penetrating wounds, and the treatment, in so far as the examination necessary to determine whether the abdominal contents are damaged or not, will also be similar; when there is no such damage the treatment of the abdominal wound will also be similar to that already described (see p. 174). If carefully sutured, there will be little likelihood of a ventral hernia occurring after healing, and we need therefore say nothing upon this point; the treatment of an actual ventral hernia is dealt with in connection with hernia in general. It therefore only remains to deal with prolapse of the abdominal contents, as the treatment of lesions of the abdominal contents is gone into fully elsewhere.

Prolapse of portions of the viscera through the abdominal wound.—When the wound is large, extensive prolapse may occur, a mass of intestines projecting through the opening in the skin. Sometimes, especially when the opening through the skin is small and the patient is very fat, the bowel may prolapse through the rent in the peritoneum and remain lodged in the sub-peritoneal tissues, giving rise to a so-called interstitial hernia. The abdominal contents that prolapse in this manner are omentum—which usually prolapses first—intestine or stomach.

This condition of prolapse of bowel or omentum adds very seriously to the gravity of the case. There is of course great risk of infection of the peritoneum from soiling of the protruded mass, the protrusion itself adds greatly to the shock, and there is considerable risk of strangulation whether the protrusion be an external or an interstitial hernia, and this risk is much increased when bowel prolapses along with the omentum. The possibility of an interstitial hernia is a very strong reason for opening up these abdominal wounds directly they are seen, for not only is it important to ascertain whether the wound be a penetrating one and to sew up the abdominal wall so that no subsequent protrusion is likely to occur, but it is also very important to see that no protrusion has taken place into the sub-peritoneal tissues as, unless the wound be thus opened up, such an occurrence may entirely escape notice until too late.

It is obvious that the prognosis and treatment must both vary according as the prolapse is seen immediately after its occurrence or as some considerable time has been allowed to elapse before the surgeon's attention is called to the case; during this time the protruded portion undergoes profound alterations and contracts adhesions. We shall therefore deal separately with the treatment of these conditions.

(a) **Treatment of recent prolapse.**—When the case is seen immediately after the occurrence of the injury, two problems present themselves. In the first place it is necessary to thoroughly cleanse the protruded mass as it is usually soiled either from contact with the ground or the clothes, and if returned in that state would inevitably set up peritonitis. In the second place, when the protruded mass contains intestine it is necessary to ascertain whether the bowel has been injured; as a rule the injured portion will be found in the protruded coils.

The first step is to cleanse the protruded mass effectually and to thoroughly disinfect the abdominal wall and the wound through which the prolapse has occurred. A certain routine should be followed in all these cases. In the first place the whole area is irrigated freely with a stream of hot normal saline solution (105° F.) flushed upon the protruded mass with some force so as to carry away all coarse particles; this may be done by raising the irrigating vessel to some height above the wound. The protruded mass is then gone over carefully with a sponge, and all recesses exposed so as to make sure that every portion of the protruded part has been thoroughly cleaned. The omentum should be spread out

upon an abdominal cloth (see p. 177) and, if it be much soiled, it will be safest to ligature and remove it. In doing this, care must be taken to ascertain the relation of the protruded part to the remainder of the omentum, as, if it be the central part and be cut away, the lower end will be deprived of its blood supply and will die; it is well to pull the omentum out of the wound and to remove the free edge with the protruded portion if necessary.

If there be no wound of a prolapsed bowel, the next step is to disinfect the abdominal wall around the wound thoroughly in the ordinary manner (see Part I., p. 161), and, while this is being done, the protruded mass (which has already been cleansed) is covered up in an abdominal cloth so as to keep the strong disinfectants from it. The next step is to enlarge the skin wound and, if necessary, that in the peritoneum so as to allow the prolapsed mass to be returned; as a rule the opening is too small to allow of this without being enlarged. The finger is slipped down beside the protruded mass and the opening is enlarged either with blunt-pointed scissors or a probe-pointed bistoury sufficiently to allow the protrusion to be returned without any force.

The peritoneum is now closed with a continuous suture and after that the muscles and skin are united, leaving in a drain for a short time. If there be any doubt about the thorough cleansing of the protruded mass, it is a very good precaution to insert the end of a fine gauze drain into the abdomen in the immediate neighbourhood of the protrusion. A temporary stitch is passed through the abdominal wall at this point and is tied when the drain is removed. The abdominal wound is dressed in the usual manner, the patient is put back to bed with the knees flexed and tied together over a pillow, a large saline enema is given and the patient treated as after an ordinary exploratory laparotomy (see p. 189)

(b) **Treatment of long-standing prolapse.**—When the protrusion has lasted some time before the surgeon sees it, extensive alterations will have taken place in the protruded parts. In the first place sepsis is sure to be fairly established, there will be adhesions between the extruded structures and the wound, and very possibly the abdominal cavity will be shut off. When the opening is small there may be symptoms of strangulation in addition, and the case may not be seen until actual gangrene of the omentum or the intestine has taken place. These conditions are therefore totally different to those seen immediately after the accident and different treatment is of course called for. It would never do to reduce the protrusion straight into the abdominal cavity, for this would inevitably entail a fatal peritonitis which is not likely to occur otherwise, as the abdominal cavity is protected by the adhesions to the margins of the wound.

When the protrusion is formed by the omentum and not more than two days have elapsed since it occurred, the abdominal wall and the protruded portion should be thoroughly cleansed in the usual way (see Part I., p. 161), scrubbing it just as the cutaneous surface is scrubbed, and then the

adhesions to the soft parts around should be detached and the omentum gradually freed and pulled out until the healthy portion is reached. The protruding portion is then ligatured off and cut away and the stump is dropped back into the abdomen; the peritoneum, muscles, and the skin are sutured in the usual manner and a small gauze drain leading down through the peritoneum to the stump of the omentum is inserted for two or three days.

When there is intestine in the protrusion which has not yet undergone strangulation, a good deal will depend upon whether the coil is covered by omentum or is exposed. In the former case the treatment is the same as for protruded omentum (*vide supra*); the latter is disinfected, carefully separated and cut off, the stump dropped back into the abdomen, the bowel reduced, and a fine gauze drain inserted. When however the intestine is not covered by omentum, the protruded portion should be cleansed with strong mixture (see Part I., p. 46), and returned just within the abdominal cavity after enlarging the opening through which it has emerged; ample provision for drainage must be made. A good plan is to leave the wound freely open for two or three days and to pack it with gauze, keeping the prolapsed coil of intestine lying at the bottom of the wound. It is also well to introduce a series of silkworm gut stitches through skin, muscles and peritoneum and to simply leave these loosely knotted together at the ends, and to introduce the gauze packing between the edges of the wound. If no suppuration or peritonitis occurs after three or four days, the packing is gradually reduced and stitch after stitch is tied so as to decrease the wound in the abdominal wall and to diminish the amount of healing by granulation that has to occur.

When the intestine has been prolapsed for some time and strangulation has occurred, the case is very serious and must be treated practically as a gangrenous strangulated hernia. If the patient's condition warrant it, the strangulated portion may be excised, while, if the general condition be very grave, an artificial anus is made by clipping away the strangulated portions and leaving the question of its closure to a later date. These methods will be dealt with fully in connection with the surgery of the intestine. In the majority of cases no doubt the latter procedure will be the better, as the wound is generally so foul that to open it up, pull out fresh intestine into this septic wound and then to excise, re-unite and put the bowel back would be almost certainly followed by septic peritonitis, whilst the patient usually makes a very good recovery after simply clipping away the strangulated bowel, and may be got into a good state for a subsequent plastic operation unless the artificial anus be situated very high up in the intestinal tract.

In some cases, though very rarely in civil practice, the omentum alone may have been protruded for several days before the patient comes under the surgeon's notice. Here the protruding portion will probably be granulating, and it is better to leave matters alone, merely applying anti-

septic dressings. Opening up the abdomen would be very likely to be followed by sepsis, whereas, if the omentum be left alone, it gradually shrinks up and ultimately cicatricises. When this has occurred, the surgeon may, if he pleases, excise the protruded portion and repair the defect in the abdominal wall with the object of preventing a ventral hernia.

INFLAMMATORY AFFECTIONS OF THE ABDOMINAL WALL.

Inflammation of the abdominal wall may be (*a*) superficial, (*b*) between the abdominal muscles, or (*c*) in the sub-peritoneal tissues.

(a) **Superficial inflammations** consist mainly of cellulitis and local suppurations of the abdominal wall, such as boils, which present no points of difference from superficial inflammations elsewhere.

(b) **Intermuscular suppuration** in the abdominal wall may follow contusions, punctured wounds or debilitating diseases, such as typhoid fever, especially after spontaneous rupture of one of the muscles. These abscesses must be treated in the usual manner and present no points of special importance.

(c) **Suppuration in the sub-peritoneal tissues.**—The most important of the inflammatory affections affecting the abdominal wall are those which occur beneath the muscles in the sub-peritoneal tissue. The most common seats of this inflammation are about the umbilicus, between the bladder and the pubes, in the epigastrium and in the lumbar region. It may occur in the course of general infective diseases, such as puerperal fever, or during convalescence from typhoid fever. It may be connected with various affections of the abdominal contents, such as injuries to the duodenum, or disease of the cæcum or the colon, the infection spreading from the intestinal canal to the cellular tissue around. It may also occur in connection with biliary calculi, in connection with the kidney or with disease of the spine or pelvis. Lastly, it may complicate bladder affections or be secondary to peri-uterine inflammation.

The abscess tends to spread rather towards the exterior than to the peritoneal cavity and is accompanied by extensive induration, which may persist long after the abscess has been opened. The pus is frequently fœtid, but this is rarely from an actual communication with the intestinal canal; it is due to the presence of the bacillus coli communis, which has found its way from the intestinal canal and is a very common cause of the suppuration.

Symptoms.—These affections give rise to very varied symptoms, the earliest of which, such as abdominal pains, colic, fever and slight distension of the abdomen are generally referred to digestive troubles. In the early stages it is not at all easy to make an accurate diagnosis; this must remain tentative until a distinct tumour has formed. The abdominal wall is usually somewhat tense for some distance around the area of inflammation; when this occurs in the hypogastric region there

may be frequent and painful micturition, and the same trouble may arise when the suppuration is in the loin. When the induration occurs, swelling may be felt when it is in an accessible part. It is very difficult to distinguish these cases from peritonitis, but the pain is more limited, there is not the same distension of the abdomen, nor is there marked vomiting. On the other hand, the symptoms may be very slight at the commencement and, especially when the liver region is affected, the swelling may be taken for a tumour; we have more than once opened abscesses in that area which had previously been mistaken for malignant growths. In some cases gas is found in the abscesses, especially when the colon bacillus is present; the diagnosis is then still more difficult.

The symptoms are usually very severe, the contents of the abscess being particularly poisonous, especially if the bacillus coli communis be present, and hence the abscess should be opened as soon as possible. In many cases, more particularly when the abscess is situated in the region of the loin, fluctuation is by no means easy to make out at an early stage, and indeed may not be evident until the pus reaches the subcutaneous tissues. Nevertheless it is not advisable to wait for evident fluctuation, for the abscess may by that time have become extremely extensive and may be very slow to heal. The rule already given with regard to deep-seated abscesses must be followed here, namely, that when the acute inflammatory symptoms have lasted for four or five days, it is almost certain that pus has formed and should be let out as soon as possible. Hence in all cases marked by acute symptoms and considerable induration which has lasted for this time, an incision should be made over the indurated area and the tissues should be gradually bored through until the pus is reached and evacuated. Even should no pus be found, the incision will afford great relief.

The *after-treatment* is the same as for abscesses elsewhere. Special mention will be made of peri-renal abscesses and those in connection with the liver and bladder in dealing with diseases of those organs.

TUMOURS OF THE ABDOMINAL WALL.

There is little to be said about these; ordinary simple tumours may occur, most frequent among which are lipomata, especially in the sub-peritoneal tissue, and fibromata in connection with the fascial coverings of the muscles.

The treatment is the same as for similar tumours elsewhere, the point of importance being whether the tumours are within or without the abdominal cavity, and this is not always easy to make out, especially in large tumours situated laterally on the abdominal wall. The chief points to notice are that the tumour is an integral part of the abdominal wall and that it moves with it on respiration and not with the abdominal contents; for instance, when the patient takes a deep breath the abdominal wall is not raised from

the tumour as it would be were the latter within the abdomen and, similarly, when the patient is rolled over to one side the tumour does not change its position as it would were it freely movable inside the abdomen. At the same time it is often impossible to be sure until an incision has been made.

A special mention may perhaps be made of the small fatty tumours which are due to protrusion of the sub-peritoneal fat through slits or openings in the fascia, generally about the linea alba above the umbilicus. Little rounded, subcutaneous tumours are thus formed, which are often intensely painful and require removal. These are sometimes real herniæ of the omentum or of an appendix epiploica and they then cause severe dyspeptic symptoms which distinguish them from the true fatty tumours of which we are speaking.

The proper treatment is to cut down, remove the protruding fat and put a stitch through the hole in the fascia. It is well to enlarge the hole and to free the fat for some distance around it, as it is not so much the protruded portion that causes the pain as the adhesion of the sub-peritoneal fat and possibly the peritoneum to the sides of the slit. The condition will be permanently cured if the slit be closed and this is also a safeguard against the possibility of a true ventral hernia.

The only other tumours of the abdominal wall which need special reference are those which occur at the umbilicus in infants. Here a simple tumour of an adenomatous character may occur about the time of the separation of the cord. Myxomata may also be met with in that situation while, later on in life, epitheliomata are not uncommon. There is nothing special with regard to their treatment, which should be removal. Hernia, which is also a common affection of the abdominal wall, will be separately referred to.

THE TREATMENT OF THE ABDOMINAL WALL IN THE OPERATION OF LAPAROTOMY.

It will save considerable repetition if we describe the treatment of the abdominal wall in cases of laparotomy. The abdomen is now opened for many reasons, and laparotomies may be divided into three large groups: first, those done to open abscesses in the abdominal cavity, such as various localised peritonitic abscesses in connection with the appendix, the liver, etc. In the second place, the abdominal cavity is very frequently opened for the treatment of various abdominal conditions that have been diagnosed beforehand and where the opening of the abdomen is therefore a prelude to some set operation. In the third place, the abdomen is now opened in an increasingly large number of cases for the mere exploration,—the so-called "exploratory laparotomy." These explorations may be either for the purpose of making a diagnosis in conditions about which nothing certain is known beforehand, or in order to ascertain the exact nature of some tumour previously felt in the abdomen and if possible to remove it.

The situation of the wound in the abdominal wall and its treatment will of course vary widely under the above conditions. The important point to bear in mind in all cases is the possibility of subsequent hernia of the abdominal contents through the cicatrix and the operations must therefore be planned so as not only to effect the object for which they are performed but also to avoid this danger.

When laparotomy is done for the evacuation of an abscess, the incision must of course be made over the abscess cavity, chiefly because it is important not to allow the pus to escape into the general abdominal cavity. In the majority of intra-abdominal abscesses that have lasted for some time the intestines are not only matted together so as to enclose the pus in a cavity, but they are also adherent to the abdominal wall and therefore an incision made directly over the inflammatory focus will probably be in the adherent region and will run little risk of generally infecting the peritoneum. In these cases, however, subsequent drainage is imperative and a hernia through the scar afterwards can hardly be avoided, and it is in them that hernia after operation is most common nowadays. In order to avoid this complication the incision should be as small as possible and the muscular fibres should be separated instead of being divided. When however there is a large abscess for which thorough drainage has to be provided it is not possible to do this efficiently through any incision which simply separates the muscles, as the tube or the gauze drain is apt to be nipped and proper drainage thereby defeated. Hence we are accustomed in the first place to make a free incision through the skin, which of itself is a matter of no consequence, then to separate the muscles over the spot at which the abdomen is to be opened, in the manner described below, so as to expose the peritoneum. This is opened and the finger is made to penetrate the abscess by separating the adherent structures immediately beneath, and proper drainage is provided for by large drainage tubes. In order to prevent these being grasped by the muscles, the latter should be nicked transversely sufficiently to leave a free passage. By proceeding in this manner the least possible damage is done to the abdominal wall and in fact the only weak spot left is the direct hole through which the tube comes. Unfortunately in a good many cases, especially when the abdominal walls are flabby, this hole remains after healing, and protrusion is apt to occur and may necessitate an operation for its closure, but the method has the advantage that, if a hernia does occur, it is through an extremely small aperture instead of being a general bulging of the scar as was formerly common.

When the laparotomy is done for the removal of some previously ascertained disease, the incision will of course vary according to the situation of the disease and will be either in the middle line or to one side. For example, in removal of the appendix the incision is made outside the linea semilunaris ; in the operations upon the gall-bladder the incision must be made outside the rectus. When only a small incision is required,

particularly in operations upon the appendix and in inguinal colotomy, the laparotomy can be done entirely without division of muscular fibres. A free incision is made through the skin, the external oblique is split in the direction of its fibres throughout the whole length of the incision, the internal oblique and transversalis are then split in the direction of their fibres and, with powerful retraction, good access may be obtained to the sub-peritoneal fat and the peritoneum. The latter is opened, the appendix removed or the colotomy performed, and the parts are allowed to fall together and no weak spot is left. In order to insure that everything comes into proper contact we are accustomed, after removing the appendix, for example, to sew up the peritoneum with a continuous suture and then to put one or two catgut sutures through the separated fibres of the internal oblique and transversalis muscles, and then to bring those of the external oblique accurately together also with catgut. The skin incision is then closed and the integrity of the abdominal wall is absolutely restored, as the openings through the various muscles do not coincide and thus there is little fear of any subsequent hernia. No doubt the operation is a little more troublesome, but the greater certainty of the result renders it worth while doing, and it can probably be carried out to a larger extent than has been the case up to recently. For instance, the kidney itself may be removed with little or no division of muscular fibres, by simply separating them and subsequently bringing them together again, and pro bably a similar thing is true with regard to the lesser operations upon the gall-bladder. When, however, the intra-abdominal operation is extensive sufficient room is not thus obtainable. We should advise that all laparotomies performed through an incision in the lateral regions of the abdomen should be planned so that the muscular fibres are separated as much as possible and not divided more than can be possibly helped. This matter will be fully discussed in connection with the various affections to which it is applicable.

In a large number of laparotomies the incision is made in the middle line and in them care must also be taken to avoid a subsequent hernia. The best way is to make the incision to one side of the middle line because repair in the latter only occurs between fibrous structures, and some weakness through which a hernia may occur is very likely to be left. The incision should be made at least an inch to one side of the middle line so that in deepening it the fibres of the rectus are separated instead of the fibrous interval between the recti being divided. The skin incision should be extensive and carried down to the deep fascia, and when the latter is reached it saves time to dissect up the skin and fat for an inch on each side (see Fig. 44); as this is necessary to enable the abdominal wall to be stitched satisfactorily together at the end of the operation. The anterior layer of the sheath of the rectus is now divided vertically, and the fibres of the muscle are separated with the handle of a knife sunk into them so as to leave a good portion of muscle on the

inner side of the separation; if one of the transverse bands of the rectus comes in the way it should be divided with the knife. The posterior layer of the sheath is then exposed and divided vertically (see Fig. 45); in order to facilitate sewing up afterwards, it is well to separate this structure from the peritoneum on each side by means of the handle of the knife. The peritoneum is now opened by a vertical incision and it will be found that it is very easy to sew up the abdominal wall accurately after the operation. The cut edges of the peritoneum are seized with tenaculum forceps, brought together by an assistant

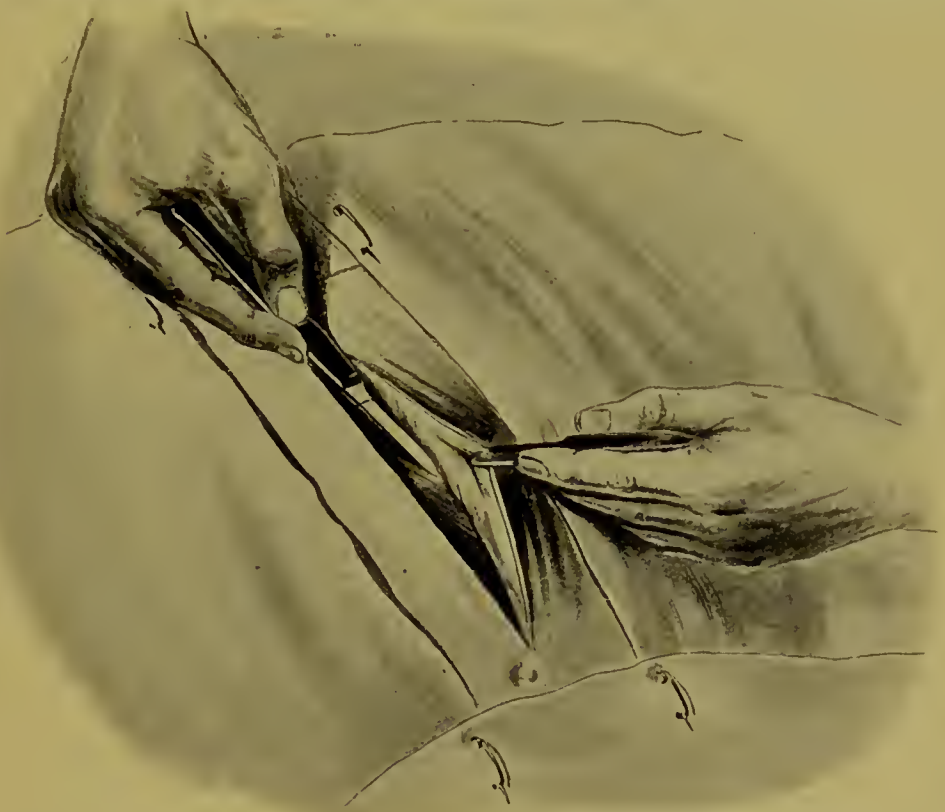


FIG. 44.—METHOD OF RAISING THE SKIN IN LAPAROTOMY BEFORE DIVIDING THE REST OF THE ABDOMINAL WALL. Before proceeding to incise the sheath of the rectus the skin is dissected off the latter by a few touches of the knife. This facilitates accurate suture of the skin-wound at the end of the operation.

and united by a continuous suture of fine catgut, the posterior layer of the sheath of the rectus is brought together with a fine continuous silk suture and the fibres of the muscle are then approximated by a few interrupted catgut stitches, the object of which is to make sure that the muscular fibres on the opposite sides of the separation are brought into apposition. The anterior layer of the sheath of the rectus is next united by a fine silk suture or, if preferred, it may be included in the stitches that bring the muscle together; on the whole, repair will be better if a separate suture be employed, provided that time allows. The skin is closed by a separate button-hole silk suture and in this way the abdo-

minal wall is stitched in three or four separate layers and the occurrence of hernia afterwards is extremely improbable.

The older plan of passing sutures through skin, muscle and peritoneum together, or the later one of sewing up the peritoneum with a separate stitch and then passing sutures through skin and muscles together, is not advisable. The sutures in the abdominal wall should be buried

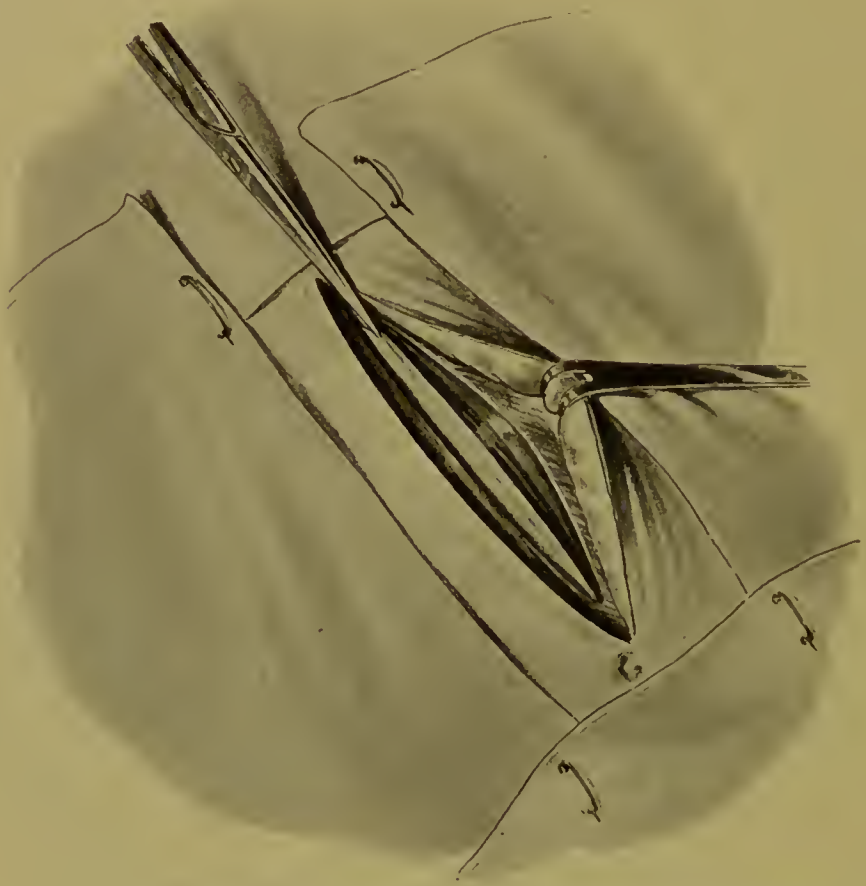


FIG. 45.—DIVISION OF THE ABDOMINAL WALL IN LAPAROTOMY. The anterior sheath of the rectus has been incised vertically a little to the left of the middle line and the muscular bundles of the rectus beneath it have been separated with the handle of the knife. The scissors are seen dividing the posterior layer of the sheath of the rectus.

and should remain in, so as to keep the parts together until the patient gets about; otherwise separation and stretching of the scar is very apt to occur. The more accurate the suture the less likelihood is there of subsequent hernia. We have often had to repair herniæ of the abdominal wall after operations which have been performed less thoroughly, and we have found it such a very difficult and to some extent unsatisfactory procedure that we think that, unless the patient be very collapsed and unable to stand the prolongation of the operation, it is well worth while to spend extra time over careful suture of the various layers of the abdominal wall. When the patient is much collapsed and when therefore time is of great moment, we would advise that silk sutures, inserted after Macewen's plan (see Fig. 46), should be carried through

the anterior sheath of the rectus, the muscular fibres, the posterior sheath and the peritoneum together, and that these should be cut short and buried, and that a separate continuous silk suture should unite the skin.

Exploratory laparotomy.—This involves such wide questions that it deserves separate consideration and will therefore be treated of later.

In connection with laparotomy in the last two classes of cases a very important point deserves mention. This is that adhesions, not only of the abdominal contents to one another but also to the wound, are very likely to occur as the result of manipulations within the abdomen. These

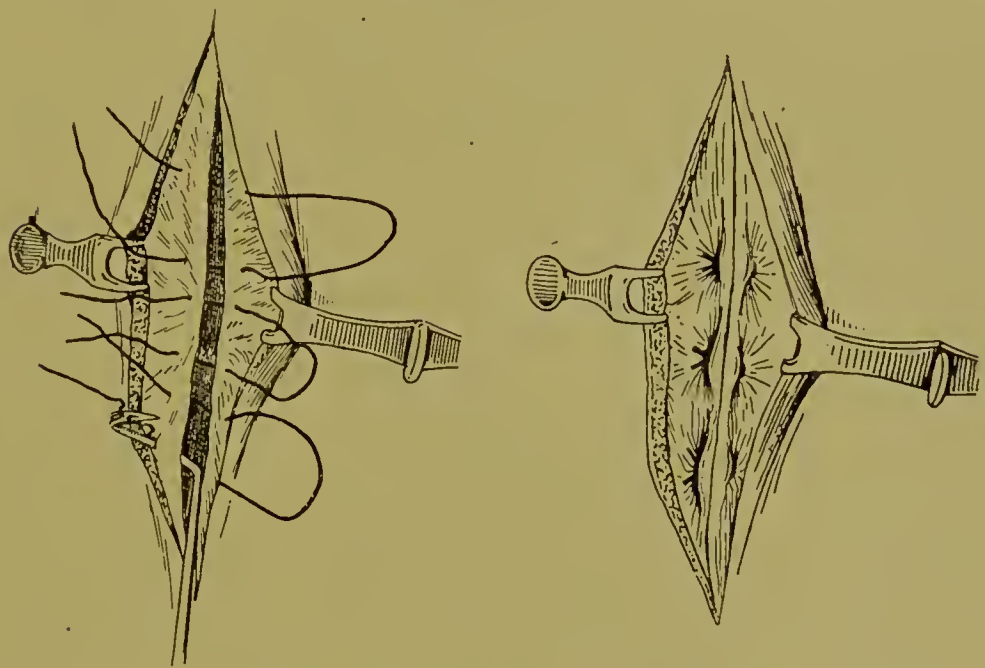


FIG. 46.—BURIED SUTURES FOR THE APPROXIMATION OF THE ABDOMINAL WALL. This is the Macewen's mattress suture which has already been fully described (see Part I., Figs. 51 and 52).

adhesions interfere seriously with the proper action of the bowels and may be a source not only of discomfort and pain but of actual danger to the patient. The principal points upon which one would rely in diminishing the chances of adhesions are the avoidance of undue manipulation of the intestinal contents and especially the avoidance of any irritation of the viscera by violent manipulation, irritating antiseptics or undue friction with sponges or cloths. All these abdominal operations should be performed strictly aseptically, just as are operations elsewhere; but it is highly important to avoid the introduction of antiseptics into the abdominal cavity, and therefore it is our practice to abandon the use of antiseptic lotions as soon as the peritoneum has been divided and to substitute for them normal saline solution (see p. 177). Through this all the instruments, the hands, sponges, cloths and swabs used inside the abdomen should be rinsed, so that there is no possibility

of carbolic acid, corrosive sublimate, or any other antiseptic coming into contact with the peritoneal surfaces.

This normal saline solution has another valuable application. It is a good plan to fill the abdomen with the solution before the former is closed, not so much from the point of view of washing it out, which is a doubtful procedure, but in order to provide the intestines with a bath of fluid in which they may remain mobile, and also to supply to the patient a fluid that can become rapidly absorbed and is calculated to act in diminishing the shock and thus to act like an intra-venous infusion of saline solution.

After laparotomy the ordinary antiseptic dressings are employed but, as there is likely to be very little oozing from the wound, only a small dressing need be employed and this can very often be fastened on with collodion if desired. At the same time, however, the support of a bandage is of considerable value as it fixes the abdominal wall, and we usually employ a many-tailed bandage applied firmly round the abdomen from below upwards. Failing this, which however can readily be made, an ordinary bandage may be employed and a sheet pinned firmly outside it. After laparotomy there is usually considerable abdominal distension from flatulence and the bandage will require to be loosened in the course of a few hours; unless this be done the patient may suffer a good deal. An additional advantage in having a many-tailed bandage is that it can be loosened without disturbing the patient. The dressing does not require to be changed for about ten days, when the stitches may be removed, and a small collodion dressing applied. The abdomen should be supported by a many-tailed bandage or a binder for about three weeks. In operations performed by splitting muscles rather than dividing them, no subsequent pad or belt is required, whether the incision be to one side or towards the middle line. The patient may be allowed to get up after the end of three weeks, and, provided he takes no violent exercise for a short time afterwards, may be considered perfectly well.

CHAPTER XII.

THE METHODS OF EXAMINATION OF THE STOMACH.

Of recent years many stomach affections have become amenable to surgical treatment, and gastric surgery is assuming a position of great importance. Among the affections now generally recognised as being suitable for surgical treatment may be enumerated the various forms of injury to the viscus, such as contusions, ruptures, or incised wounds, while foreign bodies that have been swallowed and remain located in the organ may require removal. Again, it may be necessary to open the stomach in cases of stricture of the œsophagus, most frequently for establishing a permanent fistula through which the patient may be fed, but occasionally in order to dilate the stricture and restore the passage through the œsophagus. In this connection also, as we have already pointed out, the stomach may require to be opened for the removal of a foreign body impacted low down in the œsophagus. Dilatation of the stomach, the result of obstruction, is an affection in which surgical intervention has been increasingly practised recently, and within the last few years even simple dilatation of the organ without obstruction has been treated by the operation known as gastroplication. The chief direction however in which affections that were formerly considered exclusively medical have come into the domain of surgery is in the case of ulcer of the stomach and its various sequelæ, and malignant tumours of the organ. Thus, in cases of gastric ulcer, as we shall presently point out, the surgeon may be required to intervene on account of excessive hæmatemesis or to excise the ulcer or perform gastro-enterostomy in order to enable an inveterate ulcer to heal; also operation may be necessary to save the patient's life when an ulcer has perforated. Sometimes again an abscess formed from a localised peritonitis accompanying perforation requires to be opened. Lastly, the surgeon may have to intervene on account of various contractions resulting from the ulcer, such as stenosis of the pylorus or the condition known as "hour-glass contraction" or for extensive adhesions occurring between the stomach and neighbouring parts, which interfere with the proper action of the organ and give rise to severe symptoms.

In cancer of the stomach operation is now frequently called for either in the direction of excising the tumour if possible, or if not of establishing a connection between the stomach and the jejunum in order to enable life to be carried on. Indeed, in the last few years the entire organ has been excised for this affection.

In attempting to make a diagnosis as to the exact condition present in any given affection of the stomach a variety of factors have to be taken into consideration and various methods have to be employed.

PAIN AND VOMITING.—The presence of pain referred to the stomach is of great importance, and considerable attention must be paid to its characters, situation and mode of onset. Pain, particularly after the ingestion of food, is often indicative of ulcer of the stomach, and this is still more probable when the pain is referred to one particular spot and especially if it be referred to the neighbourhood of the lower dorsal vertebræ. In other cases a diffuse pain of a neuralgic character may merely indicate some nervous affection. The most important point in connection with the pain is its relation to the taking of food and the length of time that it lasts.

Much information may also be gained by considering the question of vomiting both with regard to its frequency, the character of the vomited matters and the quantity brought up. For example, in dilatation of the stomach vomiting only occurs at infrequent intervals, sometimes only every second or third day when the stomach is much dilated, and the quantity brought up is proportionately large. On the other hand, in simple ulcer of the stomach vomiting may occur very soon after food, usually within an hour or two, and the pain complained of is relieved by it. Again, vomiting due to intestinal obstruction is not usually related to taking food and there is often constant retching. The smell of the vomited matters may also be characteristic; for instance, in dilatation of the stomach the vomit usually has a yeasty odour, whereas in cancer of the organ the contents are usually foul from decomposition, and in intestinal obstruction the vomited matters after a time become fæcal. The presence of blood in the vomit may also be strongly indicative. Profuse hæmorrhage generally implies a simple ulcer. The frequent and constant admixture of a little blood with the vomited matters, especially if these smell badly, usually points to cancer of the stomach. Profuse hæmatemesis also occurs in cirrhosis of the liver, but here the blood is usually very dark in colour, as the bleeding is venous.

INSPECTION OF THE ABDOMEN.—As a rule simple inspection of the abdomen gives little information as to the condition of the stomach. In very thin subjects suffering from pyloric obstruction it is however often possible to observe the violent peristaltic movements of the stomach immediately after taking food. In cases of cancer of the pylorus again the tumour may be large enough to be evident on the surface, or the dilated stomach may be seen through the abdominal wall. Finally, when

there is an "hour-glass contraction" of the stomach accompanied by flatulent distension, the outline of the organ may be seen through the abdominal parietes and the true condition may be suspected. Inspection of the stomach is much aided by inflation, which is an extremely valuable method of diagnosis in some cases, for, if the stomach be sufficiently inflated, its outline can be ascertained by palpation and percussion and generally also by inspection in all but very fat persons.

INFLATION OF THE STOMACH.—This valuable method of diagnosis must be used with great care. It should never be employed when there is recent bleeding from the stomach and only with the greatest caution when there is the least suspicion of a gastric ulcer. If the stomach be over-distended the ulcer may be torn, and bleeding or even perforation may occur. Should any pain result from the inflation it should be stopped at once. There are two principal methods employed for inflating the stomach; the simplest is *by the administration of effervescent solutions.* A dose of tartaric acid (grs. x-xx) is swallowed and this is followed immediately by a similar amount of bicarbonate of soda dissolved in water, or the patient may swallow the two components of a seidlitz powder separately dissolved in water. A brisk evolution of carbonic acid gas occurs in the stomach as these solutions come in contact, and the viscus becomes distended. Should the first dose be insufficient to cause the necessary distension, a second may be given. This plan, although often satisfactory and particularly valuable for nervous patients to whom the passage of an œsophageal tube is repulsive, has the disadvantage that the distension is not sufficiently under the surgeon's control and indeed might be used in a stomach that will not bear dilatation and might thus cause great distress or even possibly actual rupture.

A much better plan is to inflate the stomach *through an œsophageal tube.* A soft rubber tube, similar to that employed for washing out the stomach, is passed into the stomach (see p. 200). When this is in position, a Higginson's syringe, or better still a common bicycle pump, is attached to its upper end and the stomach may be inflated by this to any desired extent, while at the same time the degree of inflation is entirely under the control of the surgeon who can stop it at any moment he pleases and if necessary allow the air to escape immediately through the tube.

The value of dilatation of the stomach consists in defining the organ so that its outline can be easily appreciated, and, in the case of an hour-glass contraction for instance, the result is very striking. Dilatation also enables the stomach to be percussed with accuracy and it often brings a tumour of the stomach wall which was previously unnoticeable well up to the surface.

PALPATION.—By simple palpation a number of useful data may often be ascertained. In order to get the best results from this method the patient should lie upon the back on a hard couch with the legs drawn up and the head and shoulders raised upon a pillow. This relaxes

the abdominal muscles to their full extent and allows the hand to be pushed well into the epigastrium, while the stomach, provided it be movable, is carried as far downwards as possible. It is well before finishing the examination to have the trunk elevated so that the patient is almost in a sitting position, in order to allow the stomach to fall away from beneath the ribs. While the palpation is carried out, the patient should be instructed to relax the muscles completely, to keep the mouth wide open throughout the whole examination, and to breathe deeply and regularly; deep and regular breathing is of great importance for, if the hand be kept steadily pressed in upon the abdominal wall in the hypogastric region, it will be found that on each deep expiration the hand can be pressed a little further down, until ultimately the posterior wall of the abdomen can be felt.

In palpating, the hand should be applied as flat as possible to the abdominal wall and no violent or irregular pressure, such as digging the tips of the fingers into the skin, should be employed, otherwise contractions of the abdominal muscles may be set up and the object of the examination defeated. Bimanual examination does not show much except in cases of a tumour of the pylorus which has been carried well over to the right side. Palpation should always be undertaken without anæsthesia in the first instance in order to determine the question of pain, but, when the abdominal walls are very rigid or the patient is very stout, or when there is much pain, it may be necessary to administer an anæsthetic before completing the examination so as to get complete relaxation of the abdominal walls.

Before concluding the examination by palpation, the patient should always be turned first upon one side and then upon the other, and, when the examination is not under anæsthesia, he should finally be made to rest upon the hands and knees so as to allow the stomach to fall forward.

In this way tumours may be felt in the stomach walls or about the pylorus, and their size, consistence and mobility may be noted. Powerful peristaltic movements passing from left to right, such as occur when there is obstruction to the pylorus, may be appreciated. Succussion may be elicited in cases of dilatation of the stomach and also the undue sensibility of the organ so frequently associated with gastric ulcer. In the latter condition, pressure over the stomach walls usually produces a sharp pain through from the epigastric region to the twelfth dorsal vertebra.

PERCUSSION AND AUSCULTATION.—These methods are useful when employed in addition to others but are not to be relied upon by themselves. The note elicited by percussion of the stomach, although fairly characteristic, is not absolutely reliable. Percussion is most valuable when it is combined with inflation (*vide supra*). Auscultation is chiefly of value in cases of hour-glass contraction, when the characteristic rushing noise due to the passage of contents from one portion of the stomach to the other through the narrow intervening orifice may be heard. In order to make out the limits of the stomach when it is not much dilated, the

patient may be made to stand up and the limits of the stomach ascertained by percussion as far as possible. If now the supposed area of the stomach be marked out on the skin with an aniline pencil, its accuracy can be more or less checked by making the patient drink a pint or more of fluid and again percussing the stomach; this will then give a dull area corresponding to the greater curvature of the stomach. The chief difficulty in percussion is the resonance of the transverse colon, the note of which may be mistaken for that of the stomach. It has been proposed to get rid of this by means of a large water enema introduced into the rectum and left in so as to distend the descending and transverse colon.

CATHETERISATION OF THE STOMACH.—This is a method of great value and often yields the most important information. It is of course a necessary preliminary to washing out the stomach, and the information it gives as to the acidity of the gastric contents is very valuable. If practised with care and performed with a soft tube it is unattended with danger and is not therefore contra-indicated even in cases of ulceration or growth.

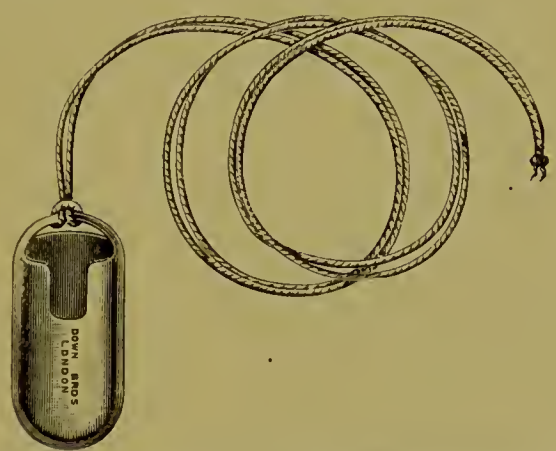


FIG. 47.—EINHORN'S STOMACH BUCKET. This little instrument is made of such a shape that it can be easily swallowed; when withdrawn by the silk threads it carries with it a sample of the gastric contents that can be submitted to analysis. It requires to be withdrawn very carefully.

Quite recently a valuable method has been introduced for the purpose of ascertaining exactly the physiological condition of affairs in the stomach. This is perhaps more useful in the medical than in the surgical affections, but is worth mentioning. A "test meal" consisting of certain quantities of particular foods is administered to the patient and then by an ingenious little bucket (see Fig. 47) samples of the gastric contents are removed during digestion at stated times after the ingestion of the meal and submitted to analysis; in this way considerable information may be obtained. On the one hand, the degree of acidity of the gastric contents at any given time, and the nature of that acidity, can be ascertained: on the other, the functional activity of the stomach may be gauged by seeing to what extent digestion has proceeded in a given time and how long is requisite for the complete digestion of a meal of given size.

From the surgical point of view this method often yields valuable results. For example, in gastric ulcer the contents of the stomach are usually thin and watery in character and contain relatively large quantities of free hydrochloric acid; whereas in cancer the fluid is thick, contains large quantities of mucus, is often foul and contains no free hydrochloric acid but comparatively large quantities of lactic acid.

Dr. Otto Grünbaum, Clinical Pathologist to King's College Hospital, has been good enough to furnish us with the following note upon the subject of test-meals:

"The object of giving test-meals and examining the different stages of digestion is to diagnose the condition of the mucous membrane of the stomach and the effective motility of that organ. Both of these are of surgical importance, since a gastritis which persists in spite of medical treatment is often due to a neoplasm, whilst motor insufficiency suggests one or more of four conditions: gastric adhesions, atony of the muscular walls, pyloric obstruction, or new growth. It is advisable to investigate these functions by giving two kinds of test-meals.

"If there be no signs or symptoms which contra-indicate the introduction of a soft rubber tube into the stomach, the administration of a test-meal is carried out in the following way:

"The stomach of the patient is washed out with warm water one evening, and early the next day a meal of 70 grams of wheaten bread is given. This should be well masticated and washed down with 350 c.c. of water, or weak tea without milk or sugar: an hour later the contents of the stomach must be syphoned off. In normal cases 30 to 50 c.c. of a homogeneous yellowish fluid with a sour smell is obtained. This fluid is kept for examination.

"The next day the peristaltic action of the stomach can be estimated by giving the well-chopped whites of two hard-boiled eggs together with 100 c.c. of water. After three-quarters of an hour another 100 c.c. of water are given, five minutes later the stomach is emptied and subsequently washed out in order to recover as much as possible of the white of egg. This is compared with the total given. If but very little has disappeared, the indications are of impaired motor function. On the third day the same procedure is repeated, but the evacuation of the stomach is deferred until 90 minutes after the administration of the meal, by which time a normal stomach should have passed the undigested proteid through the pylorus.

"The presence of much white of egg goes far towards confirming motor inefficiency.

"The fluid removed after test-meals should be examined both microscopically and chemically.

"The sediment which settles on the gastric contents standing for some hours, should be poured on to a black plate and examined with a lens for pieces of gastric mucous membrane, which if found must be hardened, cut, and stained in the usual way. If such piece of tissue show definite signs of carcinoma, the diagnosis is obvious, but it must be borne in mind that the presence of normal pieces does not exclude the possibility of malignant disease.

"In order to examine for micro-organisms some of the sediment is smeared on a slide, dried, heated to 120° C., and then stained for three minutes in a very dilute solution of gentian-violet, washed, dehydrated, and mounted.

"Sarcinæ, yeast cells, and bacilli may be seen. The two former, unless in extremely large quantities, are of no pathological significance; in very large quantities, however, they indicate stagnation.

"There are usually many different kinds of bacilli present, most of which have been introduced with the food; the one of most importance is unusually long and non-

motile. It goes by the name of bacillus genieulatus (Oppeler-Boas). This bacillus is nearly always present in carcinoma of the stomach, but is rarely found in gastric ulcer.

"The presence of blood cannot always be demonstrated with ease, owing to the changes in the red cell and in the hæmoglobin produced by digestion.

"The best method of testing is to attempt to make hæmin crystals by heating a little of the sediment on a glass slide with a trace of sodium chloride and a drop of glacial acetic acid until bubbles form; on cooling, characteristic hæmin crystals should appear. If this test be negative and yet the presence of blood be suspected, the patient must be fed on an iron-free diet for a day or two, and then the contents of the stomach must be examined for iron. A little of the dark-coloured sediment is treated with a crystal of potassium chlorate and a drop or two of strong hydrochloric acid and warmed. On the addition of a 5% aqueous solution of potassium ferrocyanide to the mixture Prussian blue will be formed if hæmorrhage has occurred.

"Two reliable reactions may be used to demonstrate the presence of free hydrochloric acid.

"A few drops of a 0.5% solution of di-methyl-amido-azo-benzol in water are placed on a white porcelain surface in close proximity to a drop or two of the filtered gastric contents. On the two fluids being brought into contact, a cherry-red colour is developed at the line of junction.

"Strong solutions of inorganic acids produce the same reaction, but they are rarely or never present in sufficient quantity to cause confusion.

"The degree of acidity of a fluid is expressed by the number of cubic centimeters of a decinormal solution of potash required to neutralise 100 c.c. of that fluid. A decinormal solution of potash contains 5.7 grams of pure dry potassium hydrate in the litre of water. The acidity of gastric contents, due to free hydrochloric acid, due to acid salts and organic acids, and due to acid albumen, ought to be estimated.

"The procedure is simple and rests upon the following colour reactions.

"Di-methyl-amido-azo-benzol assumes a red colour in the presence of free mineral acid; alizarine becomes purple in the presence of acid albumen; whilst phenol phthaleine does not assume a red colour until all acids and acid compounds have been satisfied and the solution is just alkaline.

"Into each of three beakers 10 c.c. of filtered gastric contents are placed, a drop of a 4% alcoholic solution of phenol phthaleine is added to beaker *(A)*, a drop of 1% aqueous solution of alizarine to beaker *(B)*, and one of the 5% solution of di-methyl-amido-azo-benzol to beaker *(C)*.

"A decinormal solution of potash is run into each beaker until the indicators turn colour. Let the numbers be 6, 4 and 3 respectively. The acidity due to free hydrochloric acid would be 30 degrees, that due to organic acids and acid salts 40—30, that is 10 degrees, and that due to acid combined with albumen 60—40, or 20 degrees.

"If the first and last be nil, we know that hydrochloric acid is not being secreted by the mucous membrane of the stomach; whilst if this condition persist, we have, at least, the probability of the presence of carcinoma.

"Lactic acid is not found in the presence of free hydrochloric acid, and, therefore, if the mineral acid be present, it is only a waste of time to search for the organic one.

"The recognised test for lactic acid rests upon the colour of lactate of iron; 10 c.c. of a 4% aqueous solution of carbolic acid are mixed with 20 c.c. of water and one drop of a strong solution of ferric chloride; the amethyst solution thus formed turns canary yellow on the addition of a solution of lactic acid. This test is not very sensitive in the presence of albumen, but is sufficient for diagnostic purposes, since a trace of lactic acid may be present in a normal stomach, and it is only an excess of this substance that is of pathological and diagnostic value.

"The value of proteolytic ferment may be easily investigated in the following way:

"A 1% solution of commercial white of egg in a 0.4% solution of hydrochloric acid is prepared, to 10 c.c. of this solution 5 c.c. of filtered gastric contents are added. The mixture is placed in an incubator at 37° C. for an hour and then transferred to an Esbach tube. The percentage of albumen is estimated in the usual way. A control tube to which water instead of gastric contents has been added is treated similarly.

"The result is expressed as percentage digested, by multiplying the difference in the readings of the two tubes by one hundred and then dividing by the reading of the control tube. For instance if the control tube stood at 9 and the other at 2, 77% would represent the value of the ferment.

"It is only after long-continued gastritis that the ferment disappears, and hence the frequency of carcinoma in cases where the action is weak.

"Notwithstanding all that has been said above, great caution must be exercised in drawing definite conclusions from the examination of gastric contents, for after all the only definite proof of carcinoma is the presence of carcinomatous tissue.

"The absence of hydrochloric acid, either free or in combination, points to a marked gastritis. If this be accompanied by a decrease in the proteolytic ferment, and the presence of lactic acid and the bacillus geniculatus, the condition is not pathognomonic, but the probability of carcinoma is at least a well-founded suspicion.

"It is however impossible to assert that, when free hydrochloric acid is present carcinoma is absent; for, when the new growth is grafted on the edge of an ulcer, it may be accompanied by hyperchlorhydia.

"If the growth be small, no appreciable gastritis need be caused, and hence no evidence of its existence is necessarily forthcoming."

The technique of catheterisation of the stomach is largely that of washing out the stomach.

WASHING OUT THE STOMACH.—The stomach may require washing out for various conditions: 1. This procedure was first introduced for the removal of poisons swallowed by accident or design. 2. It is also employed to withdraw the fermenting contents of a dilated stomach so as to promote its contraction. More recently it has been employed for washing out the stomach with astringent drugs, and is of course of high diagnostic value in permitting analysis of the gastric contents. 3. Perhaps the most important application of the method from a surgical point of view is as a preliminary to various abdominal operations, such as those for acute intestinal obstruction or acute peritonitis, where its object is to get rid of the contents of the stomach and so to diminish vomiting and thus to avoid the danger of vomited matters passing into the larynx during the operation.

Washing out the stomach should always be done by syphoning off the contents and never by the employment of a syringe. The apparatus used consists of an œsophageal tube about twenty inches in length connected by an inch or two of glass tubing with a piece of soft indiarubber tubing, at the other end of which is a large glass funnel capable of holding from half a pint to a pint. The œsophageal tube should be sufficiently soft to prevent all possibility of its doing damage as it is passed into the stomach, whilst at the same time it should be rigid enough not to be occluded by the pressure of the œsophageal walls. The ordinary red

rubber tubing is as a rule too soft. The best form is the double silk-web tube, which should have both a lateral and a terminal opening, so that if one gets blocked the other may act. The tube is passed in the same manner as an œsophageal bougie (see p. 109), being lubricated with butter and assisted by an actual swallowing effort on the part of the patient. As soon as the tube enters the stomach gas usually escapes through it, especially when the organ is dilated. It is usual to direct the patient to phonate so as to make sure that the tube has not passed into the larynx, but this is unnecessary, as the accident would certainly be accompanied by violent cough. When the tube is in position, the patient's head is bent well forward or turned to one side so as to allow the saliva to flow out of the mouth, and the washing out of the stomach is proceeded with.

As a rule the gastric contents begin to run from the tube into the funnel immediately the end passes into the stomach, and if required may be collected for analysis. If the fluid does not run immediately, the funnel should be lowered well below the level of the stomach and the patient asked to cough or to strain. Should this manœuvre fail, it is only necessary to fill the funnel with a little warm fluid and to raise it above the level of the mouth; then, when some of the contents have entered the stomach, the funnel is lowered and the fluid syphoned off. As much of the gastric contents as will run away spontaneously is first allowed to escape, and then the actual irrigation is proceeded with. The funnel is filled with either saline solution or boracic lotion at the body temperature, and, by raising it to the level of the mouth when the patient is in the sitting position or slightly higher when he is recumbent, this is allowed to enter the stomach gradually. Before the funnel is quite empty it is again lowered below the level of the stomach and as much fluid as will run away is withdrawn as before. This process is repeated several times until the fluid returns quite clear; it is a very much better plan than that sometimes adopted of first filling up the stomach with a large quantity of fluid and then afterwards allowing it all to run away. If one funnel-full at a time be introduced and withdrawn there is no risk of over-distending the stomach.

There are no real difficulties or dangers attaching to the procedure. If care be taken to pass the tube gently, making the patient swallow it rather than forcing it down, there is no liability for it to enter the air-passages. The operation should not be performed in cases of bad heart disease or great cachexia from constitutional mischief, where the slight disturbance caused by it might be prejudicial. It should also not be used in cases of gastric ulcer with active bleeding, or in cases of gastric cancer with free hæmorrhage. In other cases however, both of ulcer and cancer, its use is quite unobjectionable. The method is not curative, but it renders the patient much more comfortable by withdrawing fermenting contents from a stomach that is unable to pass them on, and thus diminishes the distension. It is also an exceedingly valuable preliminary to abdominal operations.

EXPLORATORY LAPAROTOMY.—This is of course the most valuable method of all and in some cases it may be indispensable, as an accurate diagnosis may be impossible without it. In addition to being of the highest diagnostic value it has the added advantage that it may be the first step in the treatment. The advisability of doing an exploratory laparotomy in a surgical affection of the stomach must however be carefully weighed. If it be quite evident from external examination and a consideration of the various symptoms that no remedial measure is possible, then, even though the surgeon may not know the exact site of the disease, no exploratory laparotomy is justifiable as it would merely be indulging curiosity. When deciding upon an exploratory operation, the surgeon must feel satisfied that the condition is one in which there is a probability of his being able to carry out some remedial treatment as a result of the exploration, and in the second place he must feel confident that the latter in itself will not be dangerous; this at any rate is necessary when there is any uncertainty about the feasibility of remedial measures.

Typical examples of the utility of exploratory operations are the following:—When a tumour is felt in the neighbourhood of the pylorus which is freely movable and accompanied by symptoms of dilated stomach, an exploration is of great importance and should be carried out at an early date because the possibilities of benefiting the patient are then very considerable. Thus the enlargement may be inflammatory, such as a thickened ulcer in the neighbourhood of the pylorus, and an exploratory operation will enable the surgeon to proceed to immediate pylorectomy or to gastro-enterostomy which will probably cure the patient. Should the swelling turn out to be a malignant tumour, the exploration will at once show whether excision of the pylorus is advisable and, if not, the patient's condition may be greatly improved by performing a gastro-enterostomy. Again, in obstinate cases of pain and dyspeptic symptoms exploration is often of benefit as it may reveal the presence of adhesions or bands, the removal of which will relieve the symptoms entirely. Or again, it may reveal the presence of an ulcer or contractions following it and these may be suitably treated. On the other hand, to perform an exploratory operation on a patient who is evidently the subject of extensive cancer of the stomach, where the chances of doing a gastro-enterostomy and thus relieving the symptoms are very slight and where the patient is obviously not in a fit condition for any severe operation such as excision of the pylorus, is merely satisfying idle curiosity. At the present day there is, not so much in the case of diseases of the stomach as in diseases of the abdomen generally, rather too great a tendency to the employment of an exploratory laparotomy to the exclusion of other methods of diagnosis. The exploration should only be employed as a diagnostic measure when other means of diagnosis fail. But whenever the symptoms point to some condition that is remediable, or when there is doubt as to the applicability of several methods of treatment, an exact diagnosis is imperative for the employment of the proper remedial measures

and an exploratory laparotomy should be done. No exploration should be practised however, even in the cases we have just mentioned, without the surgeon being prepared to go on to carry out whatever method of treatment seems most suitable.

It has happened somewhat unfortunately that large inoperable tumours have been met with when the abdomen has been opened, for which obviously nothing in the way of removal could be done, and, notwithstanding this, improvement or even cure has followed after the abdomen has been shut up. This has undoubtedly given a fillip to exploratory laparotomy even in hopeless cases, under the impression that, as a result of the laparotomy, the tumour might disappear. It is hardly conceivable that such tumours are malignant. Greig Smith has pointed out that in several of the cases upon which he operated the tumours were merely inflammatory, and to cut into an abdomen containing a typical cancerous tumour on the chance of the laparotomy leading to the disappearance of the tumour is a practice that cannot be too strongly deprecated.

Various other methods of examination have been employed, but they yield no really useful information. By some it has been proposed to ascertain the presence of a stricture of the pylorus by direct exploration with a specially designed catheter, at the end of which is a small inflatable bag which is introduced into the stomach with the bag deflated; the latter is then expanded, the idea being that, as the bag is pushed towards the pylorus, the dilated end will become arrested if there be a stricture.

Trans-illumination of the stomach has also been employed, a sound bearing an electric lamp at the end of it being passed into the viscus; the idea is to give a view of any shadow produced by growths, etc., and also to give some idea of the extent of the cavity. The stomach is previously filled with a certain amount of fluid.

Attempts have also been made to actually inspect the interior of the stomach by means of an instrument similar to the cystoscope. This method, known as **gastroscopy**, besides requiring special apparatus and being exceedingly difficult to carry out, is of such small value that it is hardly worth noticing. In most cases in which such a method would give results of value the diagnosis can be made readily by simpler means. A certain amount of information may be obtained by means of the **X-rays**. Tumours of the stomach may sometimes be detected by their shadow; foreign bodies of a metallic nature, such as knives or forks, that have been swallowed can be readily distinguished and located by their assistance. Attempts have also been made to map out the stomach area by the agency of the rays after the administration of substances which are opaque to them. One method for instance is to administer an emulsion of sub-nitrate of bismuth, which is diffused evenly over the stomach and casts a shadow to the rays. Large quantities of bismuth are necessary for this, and the drug should be introduced and washed out again by a stomach tube. Another method is to pass a long, freely flexible, hollow bougie, which is filled with nitrate of

bismuth powder; this is introduced into the stomach, made to travel along the greater curvature, and casts a shadow under the rays; the presumption is that this shadow corresponds with the outline of the greater curvature. The point at which the tube comes to a standstill is also supposed to indicate the situation of the pylorus. If arrested before it reaches the situation of the pylorus, it presumably meets with some hour-glass contraction. Others have used the same method, substituting a fine lead wire in the centre of the bougie for the bismuth.

It is obvious however that all these methods are open to so many fallacies that they cannot be looked upon as more than mere accessory methods in difficult cases, where an exploratory operation is not yet deemed advisable. None of the methods involving the passage of an instrument are permissible if there be any suspicion of ulcer or even of an actively ulcerating growth, and thus their applicability is still further limited.

CHAPTER XIII.

INJURIES OF THE STOMACH: FOREIGN BODIES: GASTROSTOMY.

INJURIES OF THE STOMACH.

Injuries of the stomach may be caused by blows, crushes, stabs, bullet wounds, etc., and vary widely in their results. In the less severe cases there is only a simple contusion of the stomach wall; in others, one of the coats of the viscus may be ruptured, usually the peritoneal covering. Finally, there may be a complete rupture of the stomach wall with extravasation of its contents; in stabs and gunshot wounds there is usually perforation. Contusions of the stomach give rise to lesions varying from superficial bruising up to damage severe enough to end in local gangrene. The stomach may be also ruptured partially or completely, the rupture being more likely to occur when the stomach is distended than when it is empty.

Perforations vary from mere punctures, such as those produced by high velocity bullets to clean-cut or contused wounds of varying size. They may be met with anywhere in the organ but are most common on the lesser curvature in the neighbourhood of the pylorus.

When the opening into the stomach is large its contents escape freely into the abdominal cavity; when, however, the opening is small this may not occur, for the mucous membrane tends to prolapse through the opening and this may so occlude a small wound as to prevent escape of the gastric contents, especially if the organ be empty at the time of the injury. If this prolapse be slight, so that the mucous membrane does not actually project into the abdominal cavity, localised adhesive peritonitis will occur around the opening which thus becomes adherent to any structure situated in its immediate neighbourhood, and the connection between the abdominal cavity and the interior of the organ is rapidly shut off and the patient may recover.

CLASSIFICATION.—These injuries may be grouped under two headings:

1. *Non-perforating wounds*, in which the mucous membrane of the viscus is uninjured and which vary from a simple contusion to a partial rupture of the gastric coats; these are usually accompanied by non-perforating injuries of the abdominal wall, such as simple contusions, but occasionally a non-perforating wound of the stomach may occur in connection with a perforating one of the abdominal wall where the injury is done with a blunt instrument the chief force of which is expended in passing through the muscles.

2. *Perforating wounds*, in which the interior of the stomach communicates with the general peritoneal cavity. These again may be subdivided into (*a*) injuries accompanied by perforating wounds of the abdominal wall and (*b*) those occurring independently of this condition. The injuries are not necessarily limited to the stomach itself; in gunshot, sword wounds and others, the pancreas, the liver or the spleen is frequently injured at the same time.

SYMPTOMS. Of non-perforating injuries of the stomach and abdominal wall.—It is often extremely difficult to separate the symptoms due to injury to the abdominal wall from those of the simpler forms of injury of the stomach. Hæmatemesis and melæna may be present but they do not indicate with any exactitude the nature of the injury to the stomach. There is usually great shock from injury to the solar plexus when the stomach is damaged and, if this be prolonged and if the local pain become more intense and the vomiting persist, a severe contusion of the stomach is most probable. This will gradually pass off in the course of three or four days unless the injury be so severe as to lead to local gangrene, when all the severe symptoms will persist and will be followed at the end of a week or ten days by symptoms either of sudden perforation or of a gradually spreading peritonitis.

Of perforating wounds of the stomach unaccompanied by a perforating wound of the abdominal wall.—In some cases the diagnosis is simple, in others it is extremely difficult. Should there be free communication between the stomach and the abdominal cavity, gas will find its way into the peritoneum; this very important symptom shows itself by distension of the abdomen and tympanites accompanied by distinct decrease of the liver dulness. There is also extreme collapse, a very rapid pulse, a peculiar anxious countenance and great rigidity of the abdominal muscles. The temperature is sub-normal, the breathing is entirely thoracic and the skin is cold; there is marked hæmatemesis.

When however the rupture of the stomach is quite small, is situated on the posterior surface, or takes place during fasting, the symptoms may be slight until acute peritonitis sets in. An important help here in arriving at a correct estimation of the state of affairs is the condition of the stomach at the time of the injury; suspicion of rupture will be aroused if the accident has occurred after a full meal and especially if there be also blood-stained vomiting, marked thoracic breathing and an

amount of collapse out of all proportion to the abdominal injury. If this condition continues and if the pulse becomes rapid and the abdomen distended as well as tender, the suspicion will become almost a certainty. Later on the liver dulness becomes obliterated from the presence of free gas in the abdomen, the pain is greatly increased and persistent vomiting occurs as peritonitis sets in. When there is any doubt it is much wiser to make a small incision in the epigastrium to ascertain the exact condition of affairs than to watch the patient until the diagnosis is certain; by that time the peritonitis which follows these accidents will have become too extensive to be successfully treated.

In order to overcome this difficulty in diagnosis it has been suggested to inflate the stomach and so to ascertain whether air passes freely into the abdominal cavity. This however is an extremely dangerous plan unless practised after the abdomen has been opened, as it is sure to force out the contents of the stomach into the peritoneal cavity and may do an infinity of harm.

It sometimes happens that these abdominal injuries are accompanied by laceration of some of the large vessels in the greater curvature or the omentum. The surgeon has then to make the diagnosis between a rupture of the stomach and internal hæmorrhage; this is a matter of vital importance as the latter condition demands immediate laparotomy if life is to be saved. This question is more appropriately discussed in connection with injuries of the intestine (see Chap. XVI).

Of perforating wounds of the stomach accompanied by a perforating wound of the abdominal wall.—Here there is much less likelihood of making a mistake in the diagnosis. There is already a wound in the abdominal wall, and the only point to settle is whether there is a similar damage to the stomach. Any suspicion, such as would be aroused by the symptoms detailed above, can easily be verified by enlarging the abdominal wound, when the condition will be evident at once. The proper examination and treatment of the wound in the abdominal wall almost certainly necessitates an anæsthetic in any case and very little more manipulation is necessary in order to settle the diagnosis.

TREATMENT. Of non-perforating wounds accompanied by a contusion of the abdominal wall.—When there is no wound in the abdominal wall and the symptoms do not clearly indicate perforation, the surgeon may be justified in waiting for a few hours to watch the course of events. The patient should be put to bed at once, surrounded by hot bottles and warmly covered so as to diminish the shock. The knees should be flexed over a pillow and the thorax slightly raised so as to relax the tension of the abdominal muscles. A large flat ice-bag (see Fig. 48) applied to the epigastric region may help to control the vomiting if this be severe. Nothing whatever should be given by the mouth, but a hot enema containing beef tea, brandy, and half an ounce of strong coffee should be administered. Strychnine (m\ v.) may be injected hypodermically if the shock be pro-

found, but no morphine should be given until it has been settled whether the wound is a perforating one or not. In adopting treatment it should always be remembered that after blows upon the epigastrium the stomach is not the only organ that may be injured. Various other structures, such as the first part of the duodenum, the pancreas, liver, gall bladder, etc., may suffer, and the surgeon's attention should not be directed solely to ascertaining the condition of the stomach. Should no perforation have occurred, the symptoms will subside gradually and the patient will be well in from 4 to 7 days.

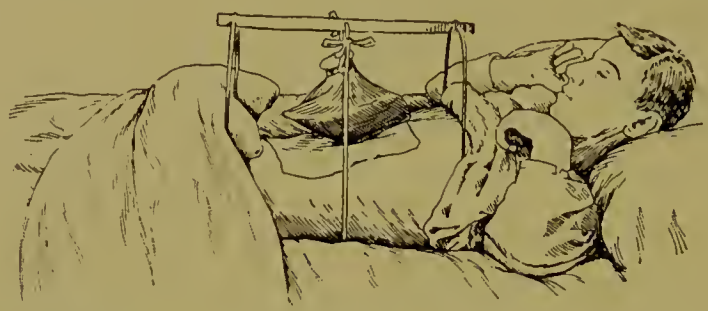


FIG. 48.—METHOD OF APPLYING AN ICE-BAG.—A large flat ice-bag is slung from a cradle and rests upon a double fold of lint next the skin.

Of perforating wounds of the stomach accompanied by a contusion of the abdominal wall.—An immediate exploratory laparotomy should be done without hesitation in all cases of contusion of the abdomen where the symptoms point strongly to the occurrence of a rupture of the stomach and, moreover, it should be done after the lapse of a few hours in the cases in which a contusion of the abdominal wall is accompanied by slight and equivocal symptoms of stomach injury which steadily increase in severity; that is to say, if after the lapse of two or three hours the collapse shows no signs of improvement under treatment, while the abdominal rigidity and distension increase, and particularly if there be signs of gas free in the abdomen, no further delay is permissible and the abdomen should be opened in the middle line. Even if no injury be found, the patient will be none the worse for the operation, while, if the stomach be ruptured, the operation may be the means of saving life.

Operation.—The most energetic *measures must be taken against shock*, not the least of which is rapidity of operating in a room that should be warmed to a temperature of 70°-75° F. This question has been gone into fully in connection with exploratory laparotomy for abdominal contusions (see p. 177) and the remarks made there apply fully to the cases under consideration.

The incision should be made in the usual manner (see p. 188) about an inch to the left of the middle line, reaching from the neighbourhood of the xiphoid cartilage nearly to the umbilicus. As a rule blood and gas will be apparent immediately the peritoneum is opened if the stomach be ruptured. In any case, retraction of the abdominal wound will render the

nature of the case evident at once. If a rupture be found, the treatment has two main objects—in the first place, to prevent further extravasation and to repair the rent in the gastric wall, and secondly, to remove the extravasated contents from the abdominal cavity. As a rule it is better to proceed with the second object first and to leave the repair of the stomach until this has been accomplished, as it is quite easy to temporarily prevent further escape of contents, whilst the longer the extravasated material remains in the peritoneal cavity the greater is the patient's danger.

Removal of the extravasated gastric contents.—The edges of the abdominal incision are widely retracted, while the rent in the stomach is covered with gauze and grasped by an assistant so as to close it temporarily and prevent further extravasation. The steps for the removal of the extravasated material will vary somewhat according to the amount that has escaped.

Should the escape of gastric contents be quite small, so that only the neighbourhood of the rent is soiled, as is likely to be the case when the opening is small and the stomach is empty, all that is necessary is to mop up the extravasated material systematically and thoroughly with pads of wool or fine sponges wet with hot normal saline solution. This should be done extremely carefully, and no rough handling is permissible; unduly vigorous manipulation defeats its own ends as it damages the epithelial lining, and may actually rub infective material into it. The surface should be gently dabbed rather than roughly sponged. When all visible extravasated material has been removed, the parts are gone over again with a fresh sponge dripping with saline solution, and the area is once more cleansed. All recesses and folds should be gently opened up in order to facilitate this cleansing, but nothing like widespread separation of coils of intestine should be practised as, in cases of a small localised extravasation, any attempt to thoroughly irrigate the abdominal cavity would be likely to do actual harm, as the fluid might disseminate the extravasated material widely over the intestines into situations from which it could not easily be removed. It is well, after having cleansed the affected area in this manner, to bring the entire stomach, great omentum and transverse colon out through the abdominal incision, and, packing them round in all directions with abdominal cloths (see p. 177) so as to shut off the rest of the peritoneal cavity, to go over these structures, the great omentum especially, a second time with special care. Solid particles very readily adhere to the omentum and are removed from it with difficulty. An excellent plan for dislodging them is to sluice considerable quantities of hot normal saline solution at a temperature of 105° F. over the omentum, and so to wash away any foreign particles mechanically; the omentum being outside the abdominal cavity, all risk of contamination is avoided. If there be any doubt as to whether the extravasation be localised or not, it is well to flush out the abdominal cavity after all the above steps have been taken.

When it is evident that the entire peritoneal cavity has probably become soiled by the stomach contents, as is most likely to occur with a wide rent

in a previously full stomach, it is obviously impossible to remove the foreign material in this manner within anything like reasonable time, and, therefore, recourse must be had to *irrigation*. The abdominal incision should be enlarged freely so as to get complete and easy access to all parts of the abdomen, and the irrigation is performed with normal saline solution, which should be used in large quantities at a temperature of 105° F.

When there is much solid matter extravasated in the abdomen, however, it is a useful precaution to mop out very gently the flanks, Douglas's pouch, and the interval between the stomach and the liver, with large soft wool pads before proceeding to employ irrigation; this should be done not, as is frequently the case, by mounting these pads upon sponge-holders and thrusting them down amongst the intestines in the desired direction, and then rotating and withdrawing them, but the areas that it is desired to clean should be opened up by separating the intestines with one hand, and the mopping should be carefully done with the pad held in the other hand. It is quite useless to expect satisfactory cleansing of the peritoneum by simply plunging sponges in amongst the intestines. Not only do they scrape the peritoneum as they pass to their destination, but the materials taken up on the sponge become wiped off against the intestinal coils as they are withdrawn, and the whole process is nullified. Cotton-wool mops are taken and the area immediately adjacent to the rent is gently and rapidly cleaned up (*vide supra*), and then the stomach (the rent in which is temporarily occluded by an assistant), the transverse colon and the omentum are turned out upon abdominal cloths and similarly treated, after which they are raised, the transverse meso-colon is separated from the rest of the intestines and the space beneath it cleansed. The intestines are next displaced from one flank by an assistant and the surgeon then mops up that area carefully and systematically, after which a like procedure is carried out on the other side, while finally the intestines are lifted up out of Douglas's pouch, which is similarly treated. Finally as many of the coils as may be necessary are separated from each other and held apart and the same treatment adopted here. The operation is completed by flushing out the abdomen.

If an irrigating apparatus be at hand, it may be employed; failing this, the fluid may be poured from a jug. The assistant raises and holds apart the cut edges of the abdominal wall so as to make the abdominal cavity contain as much fluid as possible, and a stream of the saline solution is then projected into it with some little force. When the abdomen is full, the hand introduced amongst the intestines separates them in various directions so as to facilite the access of the fluid, which is allowed to overflow from the abdominal wound and is conducted by properly arranged mackintoshes into a suitable receptacle. There are certain situations to which particular attention must be directed, and while the stream of solution is directed upon them with one hand, the coils of intestines are separated with the other, so as to open up all recesses and to enable the particles

to be mechanically dislodged and carried away. The chief of these are the region between the stomach and the liver, the flank on either side, and Douglas's pouch, as in these directions the more solid particles will gravitate and lodge. The irrigation should be continued until a large quantity of fluid (10 to 16 pints) has been used. The assistant then lets go the edges of the incision and the bulk of the fluid escapes from the abdomen.

Should there be a very extensive rupture of the stomach so that the whole peritoneal surface is soiled, and should some considerable time have elapsed between the injury and the operation, acute septic general peritonitis will be actually in progress and the best treatment then is, instead of mopping up the peritoneal cavity systematically, to increase the abdominal incision so that it reaches almost from the umbilicus to the pubes and to turn the whole of the intestines bodily out of the abdominal cavity on to hot cloths spread on the abdomen to receive them. This empties the abdominal cavity, which can be mopped up and flushed out extremely rapidly, Douglas's pouch and the lumbar region being thus rendered perfectly accessible. Moreover it has the additional advantage that the coils of intestine may be laid out upon the cloths on the front of the abdomen and examined coil by coil with great rapidity, being flushed with hot normal saline solution under fair pressure from the nozzle of an irrigator as this is done. All foreign material is thus removed and solid particles are caught upon the abdominal cloths as they are washed off the intestines and are thus not likely to infect other portions of the peritoneum. The whole operation of *evisceration* can be done extremely rapidly and, if hot saline solution (105° F.) be used for the flushing, it does not seriously add to the shock, while it facilitates the procedure enormously. If the surgeon be frightened at the severity of the collapse previous to the operation and hurries unduly over the cleansing of the abdomen or performs it in a prefunctory manner, he will lose patients who might otherwise be saved by a rather more thorough and deliberate procedure. There can be no doubt that this method of evisceration does add to the shock to some extent, although we think not so largely as has been said; but against this it must be urged that these patients are the subjects of commencing peritonitis, that they are otherwise almost certain to die of peritonitis in a day or two and that this method offers them practically the only chance. No other method is likely to succeed in removing the general infection that is present, and to refrain from evisceration under these circumstances is to withhold from the patient the only chance of recovery that he otherwise would have.

We do not wish to imply that evisceration should be practised in all cases of infection of the general peritoneal cavity. When lymph has not yet been effused, when there are no adhesions of adjacent coils of intestine and when the food in the peritoneal cavity is of a fluid nature and does not contain large solid lumps and masses, the procedures already detailed (*vide supra*) will probably do all that is required and certainly with less shock. Where however there is active adhesive peritonitis, and where therefore fluid cannot

penetrate freely to all parts and where solid masses of potato, meat, etc., are met with in the abdomen which are not likely to escape with the fluid used for flushing, the more thorough method of cleansing by evisceration must be employed.

Repair of the injury to the stomach.—After having thus dealt with the escape of the gastric contents, attention should be turned to the repair of the primary injury in the stomach. Before the assistant delivers over the wounded area that he has been temporarily compressing during the preceding stage of the operation, the stomach is brought well out through the abdominal wound and is isolated from the rest of the peritoneal cavity by packing sterilised abdominal cloths (see p. 177) around and beneath it so as to prevent the possibility of any of the contents finding their way into the abdomen. Before actually proceeding to deal with the wound, it is well to remove the remaining contents of the stomach if there be any considerable quantity left, and to inspect both the interior of its cavity and its posterior wall in order to make sure that no wound has occurred elsewhere in the organ. The contents of the stomach are easily removed either by sponges or by siphoning them off with a large tube, and the posterior wall can be examined by the finger or by actual inspection; if necessary the wound in the anterior wall should be enlarged for the purpose. This latter step is indeed generally necessary in the form of injury of which we are now speaking.

The actual treatment of the wound in the stomach wall will vary according to circumstances. In most cases it will be necessary to excise the torn edges of the wound which might otherwise slough and lead to fatal perforation. Indeed we should say that, with the exception of clean-cut wounds, it is seldom advisable to suture the opening without a previous paring of its edges. The amount of tissue removed must be determined by the shape of the rent and the apparent damage done to its edges. As a rule a very small portion will suffice, but there need be no hesitation in removing as much as may be thought desirable, as there is fortunately plenty of room in the case of the stomach. Paring the edges is best performed with a pair of blunt-pointed curved scissors and is sometimes accompanied with fairly free hæmorrhage, which however is generally mere oozing easily arrested by suturing the edges; all that is necessary is to put on a few temporary clamps until this is done. The next step is to sew up the incision and this may be done in various ways. The assistant should grasp each extremity of the incision between the thumb and forefinger of one hand and raise the whole line of incision somewhat, so as to prevent the escape of any stomach contents during suture and at the same time to steady the stomach walls. This also serves to keep the length of the incision constant and prevents the surgeon from pursing up the wound with his suture. The actual suture itself may be performed in several ways. The most rapid method where time is of importance is to close the wound by two continuous sutures, one deep and the other

superficial. The deep one is first introduced and should take up all the coats on each side (see Fig. 49); this is a very useful method of checking the oozing from the cut mucous membrane. It sometimes happens that the latter structure tends to prolapse through the opening as the surgeon is sewing it up, especially when the opening is small. If this hinders the suture at all there need be no hesitation in snipping away the redundant

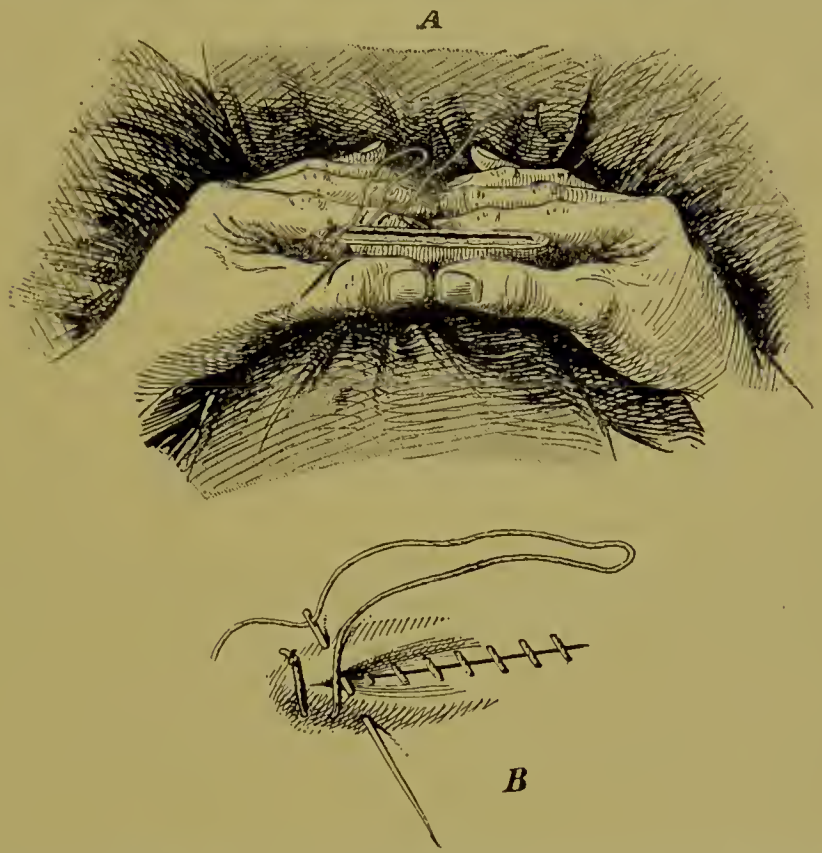


FIG. 49.—METHOD OF SUTURING A WOUND OF THE STOMACH. In *A* is shown the method of holding the edges of the wound together while the deep suture is made to take up all the coats on each side. The stomach wound is packed off by abdominal cloths. *B* shows the deep suture in process of being buried by the superficial running stitch taking up the serous and muscular coats only.

portion with scissors. This deep suture shuts off the gastric cavity and all that is necessary is to insert outside this a second continuous running stitch of fine silk taking up merely the serous and muscular coats on each side and commencing about a sixth of an inch external to the deeper one and extending a good half inch or more beyond it at each extremity, so as to invaginate and bury the deeper suture by approximating the peritoneal surfaces over it. This is a form of Lembert's suture.

Lembert's suture.—By Lembert's suture (see Fig. 50) is meant one passing through the serous and muscular coats only on each side of the wound; it does not enter the lumen of the bowel. The needle is introduced through the muscular coat a little away from the edge of the wound and is made to emerge immediately external to it, thus taking up a small portion

of the serous and muscular coats. It is then introduced close to the edge of the wound on the opposite side, passed through the serous and muscular coats as before and brought out a short distance (an eighth of an inch) beyond that. The result is that the free edges of the wound are tucked in when the ligature is tied and a certain breadth of the peritoneal coats on

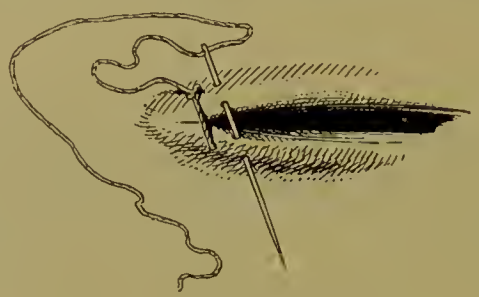


FIG. 50.—CONTINUOUS LEMBERT SUTURE. The sketch shows how the needle (which only passes through the serous and muscular coats) is inserted with regard to the edges of the wound. It also shows how the latter become inverted when they are approximated.

opposite sides of the wound is approximated. In applying the suture the needle must not be entered too far away from the cut edge as otherwise a considerable portion of the muscular coat is included and there is a corresponding diminution in the lumen of the viscus.

Lembert's sutures were originally interrupted ones, but his principle of taking up only the sero-muscular coats is now applied in the form of a continuous suture which is either a button-hole or a simple running stitch. As the continuous running suture is drawn tight it is apt to pucker up the intestine and it is therefore well never to make this suture of too great a length; after the first inch or inch and a half it should be tied and another begun so as to avoid puckering. With a button-hole suture as for the skin (see Part I., p. 158) the puckering is not nearly so great, but at the same time great care is required to see that the suture is drawn sufficiently tight as otherwise the approximation will be imperfect. These sutures may be introduced with either a curved or a straight needle. If the surgeon be working in the interior of the abdomen a curved needle will be found more suitable, the particular curve depending upon the part sutured; for the mucous membrane a fully curved needle is usually best; one with a smaller curve will be found more convenient when Lembert's sutures are being put in. When the suturing is done outside the abdominal cavity, it is much more rapidly and conveniently done with a straight spring-eyed needle, which can be obtained of any draper.

The material for the suture may be either fine catgut or silk. It is really not a matter of any consequence. When we are employing a double suture, the inner to unite the cut edges, with a Lembert's suture outside, we use catgut for the former because it is more easily absorbed and the portions will soon drop off into the intestinal cavity; for the Lembert suture we use fine silk, which is not nearly so rapidly absorbed; this is however more a matter of habit than one of real importance.

Another method which we often employ and which is very satisfactory giving a firm line of union but requiring somewhat more time for its performance, is to make the deeper row of sutures the so called *Halsted's mattress stitches* of catgut inserted as shown in Fig. 51 by a straight needle threaded to each end of the suture. A sufficient number of these stitches are inserted and tied and their effect is to invert the cut edges and to approximate the peritoneal surfaces to one another on either side over an area of about a quarter of an inch in length. This deep layer of sutures is then reinforced by a second or superficial suture of fine silk, which may either be the ordinary continuous running suture previously described or the button-hole stitch similar to that employed for skin wounds (see Part I., p. 158). The latter, although taking somewhat longer to insert, secures better approximation of the peritoneal surfaces and is quite easy to introduce in the particular organ we are considering, while at the same time it

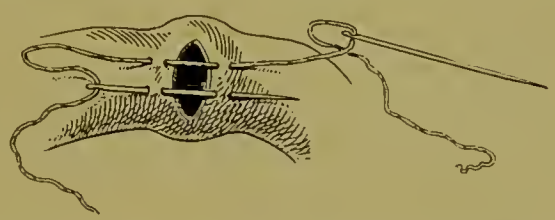


FIG. 51.—HALSTED'S INTESTINAL SUTURE. Each end of the suture is threaded on a separate needle. Each needle is then inserted as shown in the sketch, and the two ends of the suture are pulled upon and tied; this causes a fairly wide approximation of the serous coat, and a good reliable stitch. The needles only take up the serous and muscular coats. The suture is necessarily an interrupted one. Compare also Fig. 58.

does not run any risk of puckering up the incision. This continuous suture is commenced and finished well beyond the extremities of the deep one.

Closure of the abdominal wound.—Nothing now remains but to mop up the anterior surface of the stomach carefully, to repair any other wound that may be found in a similar manner and then to remove the abdominal cloths and drop the stomach back into the abdominal cavity. It is well, immediately before proceeding to close the latter, to fill it up afresh with as much hot normal saline solution (105° F.) as it will hold; this may be poured in from a large jug. The abdomen is then closed in the usual way, but in doing it the very important question will arise as to whether *drainage* should be practised. Experience has shown that many cases do extremely well without any drainage whatsoever and, if the surgeon be fairly sure of having removed all the infective material, especially if the area of extravasation be small and the wall of the stomach be healthy, the abdominal cavity may be safely closed without drainage. On the other hand, where there is doubt there is no particular objection to the introduction of a drainage tube through the abdominal wall, which should pass down to the neighbourhood of the opening in the stomach and should be packed around with a little gauze,

so as not only to drain the part but also to promote adhesions around and so to shut off the drained area from the general peritoneal cavity. This is particularly useful when there is any doubt as to the vitality of the stomach wall in the neighbourhood of the rent and where therefore a safe track is provided should perforation subsequently occur. It can be only in this way that drainage is likely to be of any use. A tube inserted into Douglas's pouch or even into each flank can only have quite a local action, as its presence leads to early adhesion of the intestines around it which shuts off the rest of the peritoneal cavity from its influence. As a matter of fact the surgeon must rely for the prevention of septic peritonitis entirely upon the thoroughness with which he removes the extravasated material at the time of the operation, and the only field for drainage is to provide a safe exit for a possible perforation after the operation. If portions of the gastric contents remain behind, the patient will certainly die of peritonitis, and, unless the conditions be such that thorough cleansing can be obtained, it is better to do no operation at all.

Should no perforation be found and should there be no intra-peritoneal hæmorrhage from rupture of one of the abdominal organs, the first part of the duodenum should be examined before the abdominal wound is closed and the condition of the posterior wall of the stomach should also be ascertained, as injuries may occur in this situation from severe blows on the epigastrium without any wound of the anterior wall of the stomach.

Of perforating wounds of the stomach accompanied by a perforating wound of the abdominal wall.—In civil practice when the patient is under suitable conditions it may be laid down as a general rule that wounds of the abdominal wall over the region of the stomach, whether inflicted by knives or similar instruments or the result of a bullet wound, should always be examined at once and the condition of the stomach ascertained. The abdominal wall should be thoroughly disinfected, the wound cleansed and if necessary enlarged and care must be taken not to allow the antiseptic to run into the abdominal cavity. When the direction of the wound renders it probable that it has reached the stomach, the question will arise whether it is better to enlarge the existing opening in order to examine that organ, or to make a fresh vertical incision in the usual situation, a little to the left of the middle line. If the abdominal wound be close to the latter it should be enlarged, but if it be much to one side it is more convenient on the whole to make a fresh median incision. The steps of the operation need not be recapitulated here (*vide supra*).

The treatment of the injury to the stomach will be much the same as for the cases already described (*vide supra*) and if the wound has been inflicted with a sharp cutting instrument the edges will be probably quite healthy and may be inverted and sutured without paring the edges. If however there be any contusion of the edges the margins should be pared so as to leave clean-cut healthy surfaces. In gunshot wounds it is

always advisable to excise the track of the bullet, and this must be done more freely in the case of those of low velocity than in those inflicted with military weapons such as the Mauser rifle.

The question of drainage will be determined by considerations similar to those applying to the cases unaccompanied by a wound of the abdominal wall and if necessary should be effected in the same manner (*vide supra*). With regard to gunshot injuries of the abdomen we may here point out the advisability of avoiding operations in many cases in military practice, but in civil practice we do not think that the old rule demanding immediate operation for all cases of suspected injury to the viscus need be departed from; the case can be attended to at once, and everything that is needful will be at hand.

After-treatment.—An enema containing hot coffee (2 oz.), brandy (1 oz.), beef-tea (1 oz.), and liq. strychninæ (♏ x), and an injection of morphine should be given as soon as the patient recovers from the anæsthetic, and the feeding should be entirely rectal for four days (see p. 234). There is generally very distressing thirst, which is best allayed by giving daily two or three enemata containing a pint to a pint and a half of normal saline solution at the body temperature; at the same time a little ice or a very small quantity of hot water, which may if desired contain a little brandy or other stimulant, may be given by the mouth every hour if it does not excite nausea; the quantity however should not exceed a teaspoonful at a time. Intra-venous saline infusions will be required if the shock be intense (see Part I., p. 136).

If there be no bad symptoms after four days a small amount of peptonised food may be given by mouth; half an ounce at a time should be given every three hours and this should be gradually increased in quantity and frequency until, in about ten days or a fortnight, the patient may be allowed semi-solid food in gradually increasing quantities.

As a rule these patients should lie upon the back with the knees flexed over a pillow and the thorax slightly raised by pillows so as to relax the abdominal muscles. If the patient cannot rest flat on the back he may be turned a little to the right side by propping up the left side of the chest.

Morphine, preferably hypodermically, may be required for pain or restlessness during the first three or four days, but it should not be employed unless it is distinctly indicated, as it disorders the digestion and may cause much trouble with the bowels. For mere restlessness, as apart from pain, such drugs as the bromides of ammonium and potassium and chloral hydrate are better suited.

The question of the bowels must be very carefully considered. It is of the first importance that no flatulent distension should be permitted, as the union of the wound in the stomach will otherwise be seriously endangered. Enemata should be given daily after the first 24 hours and if they bring away nothing but the débris of the nutrient enemata, a

drachm of turpentine may be added to each. On the fourth day an aperient should be given by mouth and for this purpose there is nothing better than five grains of calomel.

When the abdominal wound has been sutured completely, no special after-treatment is required in respect to it; no pad is required and the patient may be allowed to get up at the end of about three weeks wearing a firm abdominal bandage, which should be continued for about two months after the operation. When drainage has been employed however there will be a tendency to ventral hernia through the track of the tube. This may be prevented to a certain extent by passing sutures through the abdominal wall where the tube emerges, leaving their ends long and tying them when the tube is withdrawn, so as to produce a minimum of healing by granulation. It is nevertheless well, whenever drainage has been employed, to make the patient wear a broad abdominal bandage fitted with a suitable flat pad overlapping the cicatrix in all directions; the pad must not be conical or its pressure will weaken the scar and make a hernia certain.

FOREIGN BODIES IN THE STOMACH.

Foreign bodies in the stomach are very common, but the majority are insignificant and cause no trouble; they find their way along the alimentary canal and are passed *per rectum*. The commonest of these are small coins, buttons, beads, pins, fruit-stones, etc. A rarer but much more important group of cases are the large foreign bodies which have been swallowed by accident or design; toothplates, knives, forks, etc., sometimes lodge in the stomach, and in women, especially lunatics or extremely hysterical subjects, balls of hair, sometimes of enormous size, may form in the stomach as the result of the practice of constantly biting the ends of the hair. When a large body reaches the stomach its escape may be prevented because its size or its shape renders it unable to pass the pylorus or because it possesses sharp points which penetrate the stomach walls and may cause fatal perforation.

The presence of a foreign body of this kind is usually easily recogised. In the first place the history of the case is often quite clear; no mistake can well be made when the patient swallows a toothplate or a public performer swallows a knife, while in the case of lunatics the history is also usually clear. In addition to this, there are the local symptoms such as constant pain and tenderness on palpation, and sometimes there is a swelling to be felt in the stomach; in a large number of cases the X-rays will determine at once the existence of a foreign body and its situation.

TREATMENT.—(a) Of small smooth bodies.—Small foreign bodies, such as those usually swallowed by children, require very little in the way of treatment. All that is necessary is to facilitate their passage through the pylorus and along the alimentary canal. For this purpose it

has long been the custom to give as food tenacious substances, such as porridge, thick rice pudding, or figs, with the object of entangling the foreign body, filling up any crevices in it, and so converting it into a smooth object which can pass readily along the alimentary canal.

(b) Of large bodies.—When the body is too large to pass through the pylorus, it will give rise to much distress, and, if it should possess sharp points or edges, there is very serious risk of ulceration and perforation; its removal is therefore urgently called for.

Gastrotomy.—If performed as soon as it is evident that the foreign body will not pass safely along the alimentary canal, gastrotomy is very simple and safe, whereas, if it be delayed until the foreign body has set up inflammatory changes in the stomach wall, the risk is considerable. An incision should be made a little to the left of the middle line, commencing about the tip of the xiphoid cartilage and running down vertically for about four inches. The method of opening the abdomen has already been described (see p. 188). If the stomach does not present at once on incising the peritoneum and separating the edges of the abdominal wound, all that is necessary is to push down the great omentum and the transverse colon, when the stomach will come into view, and there will be no difficulty in making out the position of the foreign body. The stomach should now be pulled gently out of the wound and shut off from the rest of the abdominal cavity by abdominal cloths (see p. 177).

The next step is to open the stomach, and the seat of election for this incision is on the anterior surface about midway between and parallel to the two curvatures; here the vessels are smallest, and there is consequently less bleeding, whilst the incision lies immediately under observation. Should a sharp foreign body be definitely impacted in some other part of the anterior wall it may be advisable to make the incision directly over it. The opening should be free enough to withdraw the foreign body without stretching or damaging the stomach walls, as an increase in the length of the scar is of no consequence in comparison with the risk of bruising the stomach. The best way to make the incision is to cut through the serous and muscular coats first with a knife, and, when this is done, the cut edges are seized with catch forceps and raised by an assistant so that, when the mucous membrane is incised, the exit of the stomach contents is prevented. The mucous membrane is then picked up with forceps, and a small hole made into it with a knife, the incision being completed with blunt-pointed scissors; in order to prevent troublesome prolapse of this structure in suturing afterwards, it is well to clip away some of the redundant portion which always presents in the wound. The foreign body will now be exposed, or, if not, it is felt for and removed by suitable forceps, the incision in the stomach being enlarged if necessary in order to extract it without force. There is no difficulty, as a rule, in removing it if the incision be of sufficient size, and the body be manœuvred so as to bring its shortest axis out through the wound. If, however, the body be actually perforating any of the gastric

coats it must be disentangled with the greatest possible gentleness, and great care must be taken not to cause a perforation in so doing; if necessary it may be broken up with cutting pliers and removed piecemeal. The seat of impaction should be examined to see whether the stomach wall be extensively damaged, and, if so, this must be treated much in the same way as an ulcer of the stomach, either by excision or by inversion and suture of the stomach walls (see Chap. XIV.). This is another important reason for making the incision directly over the body when it is impacted in the anterior wall; the surgeon can then readily clip out the damaged portion of the wall and obtain perfectly healthy surfaces for suture. After the foreign body has been removed, the incision in the stomach wall is picked up by the assistant and is sutured as already described (see p. 212). The anterior surface of the stomach is next carefully cleansed with soft mops, the abdominal cloths are removed, the stomach is dropped back into place, the abdominal wound closed in the usual manner (see p. 190), and the usual dressings applied. There should be absolutely no risk of fouling the abdominal cavity if the abdominal cloths be properly arranged, and no drainage is necessary. The after-treatment is identical with that for wounds of the stomach (see p. 217).

GASTROSTOMY.

It will be convenient to consider this operation before proceeding to deal with the diseases of the stomach itself. It is chiefly called for in stricture of the œsophagus, and the indications for its performance have already been mentioned (see p. 120). All that is necessary here is to describe the steps of the operation and the main points to be borne in mind in performing it. In the first place, the method chosen should be one that can be done within a reasonably short time, as the patients are not usually in the best condition when the operation is done: in the second place, the risks of peritonitis, which were extremely great in the older operations, should be reduced to a minimum and should practically never be run nowadays: thirdly, no operation should be considered thoroughly satisfactory unless it be so planned as to prevent leakage of the gastric contents through the artificial opening,—an event accompanied by such intense irritation of the skin around as to render the patient's condition extremely pitiable. Not only has gastrostomy been largely freed from risks of sepsis in recent years, but it has been practised much earlier in the course of the disease, and operations have been introduced that reduce leakage to a minimum and so the results have proportionately improved. There are practically only two operations of high excellence and these we shall describe here. For their various modifications text-books on operative surgery may be consulted.

The two forms referred to are those known by the names of Witzel and Franck. In Witzel's method an opening is made into the stomach at

the time of operation, and from this aperture a tubular or funnel-shaped track is constructed extending to the skin incision; this track serves for the introduction of food into the stomach and also acts as a valve to prevent regurgitation. In Franck's operation the barrier against regurgitation is provided by pulling out a portion of the stomach through the abdominal wall and altering its direction so as to make a somewhat S-shaped kink. Each operation has its own special indications but on the whole Witzel's operation is applicable to the larger number of cases, as it can be done in a very contracted stomach, whereas Franck's cannot. On the other hand, in inexperienced hands there is a certain amount of danger of sepsis attaching to Witzel's method which is absent from Franck's.

Witzel's operation.—The stomach is reached by the usual vertical incision about an inch to the left of the middle line, running about four inches downward from the xiphoid cartilage. The stomach is exposed and pulled up into the wound or, if its size allows, outside it altogether. The rest of the abdominal cavity is carefully packed off with abdominal cloths (see p. 177), and a small opening is made through all the coats of the viscus on its anterior surface about midway between the two curvatures and rather towards the cardiac end. This opening should be large enough to admit a No. 12 gum-elastic catheter with ease. A catheter of this size is taken, the terminal 5 inches are cut off, the tip is softened by heat, bent at right angles an inch from the point, and introduced into the orifice in the stomach; the remainder is laid along the wall of the stomach running from left to right. A piece of india-rubber tubing is fixed over the outer end of the catheter so that, should the patient vomit, the gastric contents are conveyed away from the wound and do not soil it. The serous and muscular coats of the stomach are now brought up over the catheter on each side by means of Halsted's sutures (see Fig. 52) so as to entirely surround it and form a tube about an inch and a half or two inches long; enough of the stomach wall on each side must be taken up to obviate any tension on the stitches. Outside this row is applied a second continuous sero-muscular suture which approximates a good broad surface of peritoneum over the catheter on each side, and this should be carried well beyond the point of entrance of the tube into the stomach so as to prevent leakage.

When the catheter has been thus enclosed in the tube or canal of stomach wall the next point is to fix the outer end of this to the opening in the abdominal wall. The peritoneum is therefore sutured above and below leaving a small hole about the centre of the incision through which emerges the tube and the portion of stomach folded round it (see Fig. 53). In sewing up the upper portion of the peritoneal wound it is very important indeed to insert two or three of the sutures through the stomach wall as well, so as to bring the line of sutures forming the stomach tube well up beneath the incision. The two opposed surfaces will then become adherent and form an additional means of closing in the tube and will at the

same time anchor the stomach firmly to the abdominal wall so that there will be no risk of its dragging away as it might were it merely stitched round the opening left in the peritoneum. If this precaution be omitted

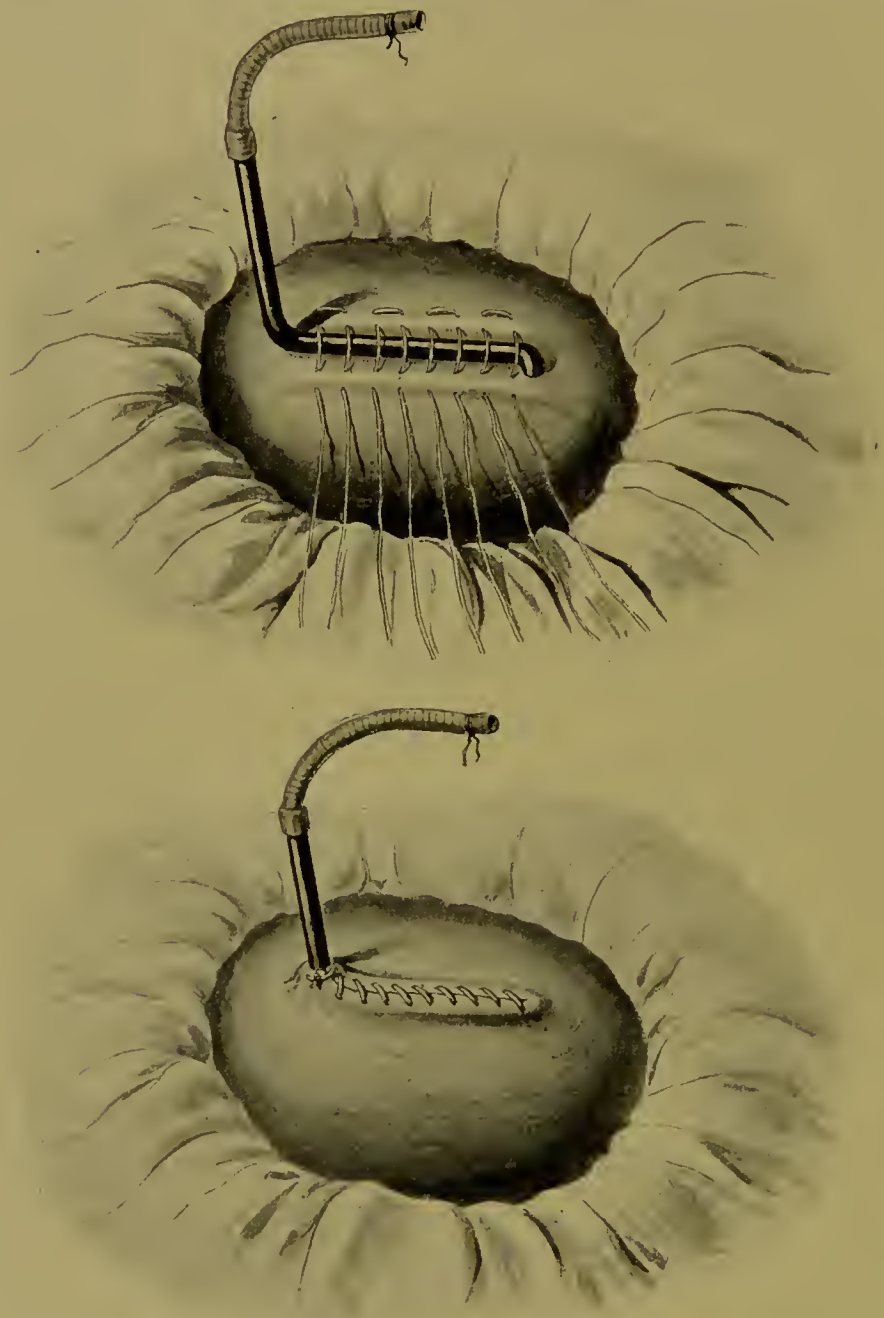


FIG. 52.—WITZEL'S GASTROSTOMY. *Formation of the stomach tube.* The upper sketch shows the tip of the catheter inserted into the opening in the stomach, and four Halsted's sutures in place and ready to fold the stomach wall up round the catheter.
The lower figure shows the catheter in place, the row of Halsted's sutures being buried by a continuous catgut stitch.

it is quite possible that leakage may occur between the stomach and the abdominal wall. All that now remains to be done is to suture the circle of stomach wall emerging through the opening in the peritoneum, first to the edge of the latter, and then to the skin incision; in order to do

this, the tube of stomach around the catheter is pulled well forward by an assistant. The result is that the catheter passes through the skin incision along a tube formed by the folded stomach wall, at the further



Fig. 53.—Witzel's Gastrostomy. *The method of securing the stomach to the abdominal wall.* The peritoneum and the posterior layer of the sheath of the rectus are united by a continuous suture which also takes up the muscular wall of the stomach near its centre. The portion of stomach round the tube is also sutured as shown above.

end of which it passes through an opening into the stomach. No regurgitation is likely to occur, as the tube will collapse when the catheter is taken out and its walls will be firmly approximated by the pressure of the stomach contents (see Fig. 54).

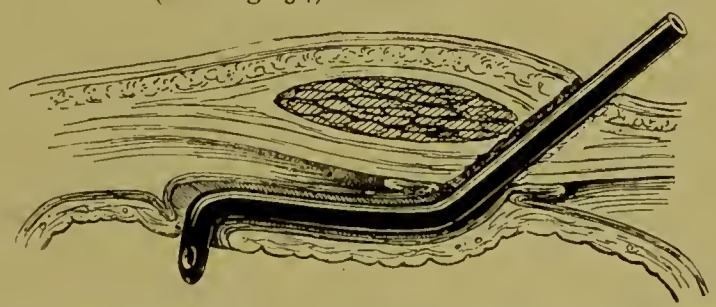


Fig. 54.—Horizontal Section in Witzel's Gastrostomy. (Diagrammatic.) Showing the catheter passing from the interior of the stomach to the opening in the abdominal wall. The tube in which it lies is lined by peritoneum, and not by mucous membrane as is the case in Franck's operation. (See Fig. 57.)

The patient is fed upon the operating table with a meal consisting of four to six ounces of peptonised milk containing half an ounce of brandy, and he may be fed in a similar manner every four hours. It is well to add ten grains of salol to the first feed to prevent putrefaction of any blood that may have found its way into the stomach.

After-treatment.—The wound heals readily and the patient may usually be allowed to get about at the end of a fortnight. The tube should not be left out for at least a month or six weeks, as there is a constant tendency for the canal to contract and to render the insertion of a fresh tube difficult. The tube should however be changed every day, a fresh one being inserted immediately after the old one is removed, so as to avoid decomposition along the track. It will be necessary to have a piece of india-rubber tubing attached to the end of the tube and provided with a proper clip to prevent escape of the gastric contents; the whole is fastened on with a binder. After about two months the tube may be left out, and need only be inserted for purposes of feeding. It is well to provide the patient with a black olive-ended catheter for feeding purposes, as its tapering end enables it to be passed into the wound more certainly and with less risk of damage than the ordinary blunt-ended form. Feeding can easily be done by the patient himself; he pours food into a glass funnel whence it runs through the tube by means of a few inches of india-rubber tubing, the funnel being held slightly above the level of the stomach.



FIG. 55.—FRANCK'S METHOD OF GASTROSTOMY. *First stage.* The anterior wall of the stomach is pulled out through the opening in the posterior layer of the sheath of the rectus just to the left of the middle line. It is held over to the left side as shown in the figure, and its sero-muscular coat united to the right-hand edge of the incision in the sheath of the rectus by a continuous running suture. The sketch also shows the second smaller incision above and to the left. This only goes as deep as the fibres of the rectus.

Franck's operation.—Franck's or Albert's method is perhaps more popular than Witzel's and is performed as follows. The stomach is exposed as before and its anterior wall is seized and pulled well out through the

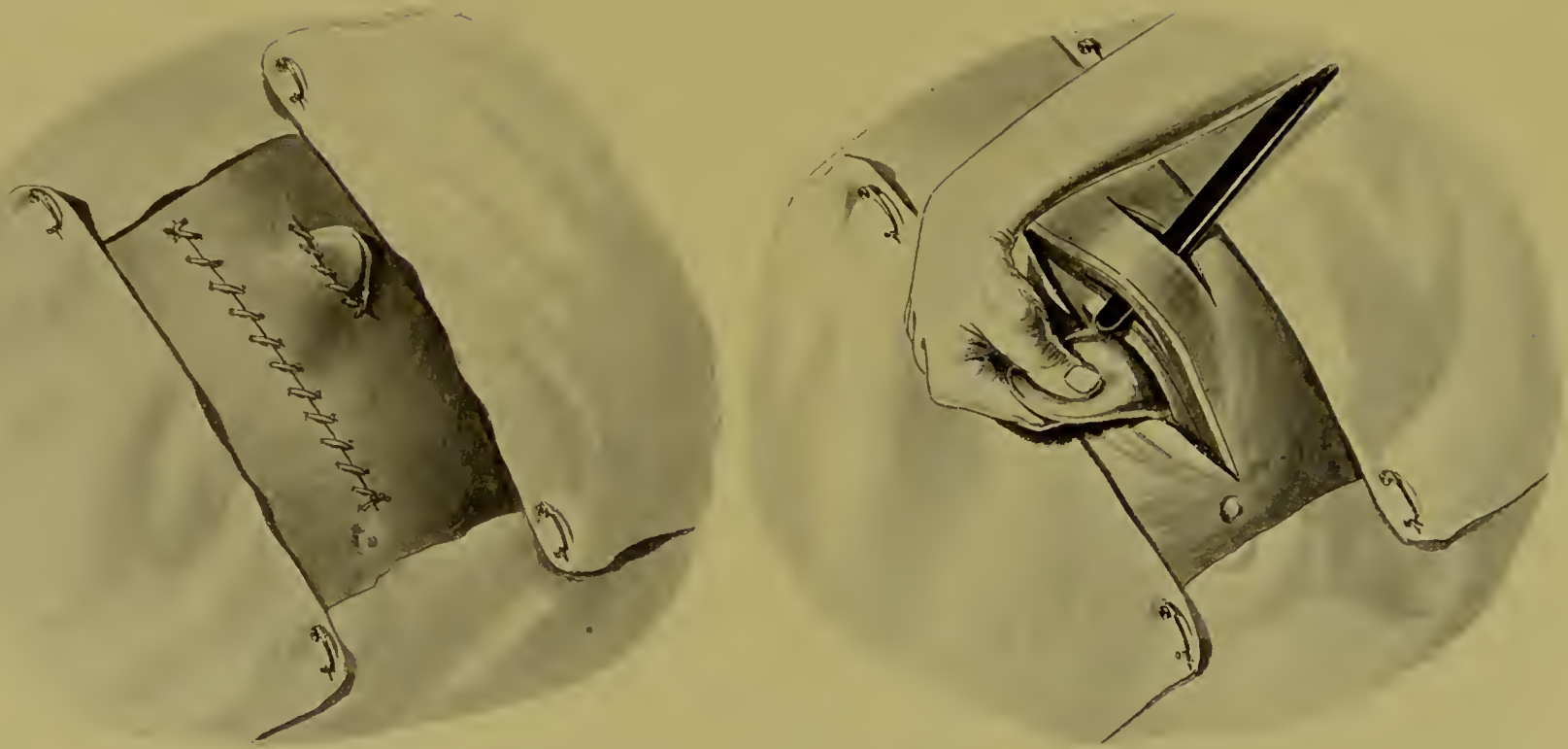


FIG. 56.—FRANCK'S METHOD OF GASTROSTOMY. *Final stages.* In the right-hand sketch is depicted the second stage of the operation, which consists in making a communication between the two wounds preparatory to bringing the stomach out through the second opening. The spatula lies in the channel of communication which, it will be noticed, runs horizontally through the substance of the rectus. This is done to secure some sort of sphincter action. There is no need to insert sutures between the stomach and the edge of the incision in the rectus shown in the sketch; there is no traction on this edge and the suture already inserted on the opposite side (see Fig. 55) secures the stomach in place. It may, however, be done if desired.

In the left-hand sketch the operation is shown completed. The stomach wall has been pulled through the tunnel in the rectus and sutured to the edges of the smaller wound. This suture goes all round the protrusion. Two guiding stitches for assistance in opening the stomach subsequently are usually inserted at the upper and lower extremities of the protrusion, but are not shown in the figure. The original median incision is closed entirely. The suture used for this purpose should have been the ordinary button-hole stitch.

abdominal wound. The portion chosen should be towards the pyloric end and as much is pulled out as will come without exerting undue traction; the posterior wall of course is not pulled out. This portion of the stomach is now given to an assistant to hold whilst the surgeon makes a second small incision about an inch long and an inch and a half above and external to the commencement of the first (see Fig. 55). This incision only goes through the skin, fascia and anterior layer of the sheath of the rectus, and the two wounds are now made to communicate by carrying the handle of the knife horizontally through the fibres of the rectus from one incision to the other (see Fig. 56). In the original operation the communication was made merely beneath the skin; it is however well to split the rectus in this way, as it then forms a muscular band surrounding the portion of the stomach that is pulled through it and thus may have some sort of sphincter action. This gives an incision in the abdominal wall through which the anterior wall



Fig. 57.—Horizontal Section in Franck's Gastrostomy. (Diagrammatic.) The diagram shows the S-like curve of the fistulous opening and its passage through the rectus muscle.

of the stomach is pulled out, and this communicates by means of a track through the centre of the rectus with a second incision above and external to the point of emergence of the stomach through the peritoneum (see Fig. 57).

The stomach is finally carried through this communication and brought out through the skin at the second incision where the protruded portion is grasped by an assistant. All that now remains to be done is to prevent the stomach slipping back into the abdominal cavity, which is easily accomplished by suturing the right-hand edge of the incision in the sheath of the rectus to the adjacent surface of the viscus; the peritoneum should not be taken up in the sutures, as firmer adhesions are obtained without it. It is usually recommended to sew the stomach to both edges of the incision, but it is really unnecessary to do so on the left-hand side, as the organ is firmly flexed over this edge. Finally, a few stitches are inserted between the second skin incision and the portion of the stomach wall emerging from it, and it is well to insert into the latter two silk stitches, which are knotted and left long so as to serve as guides for the subsequent artificial opening. The operation is now completed by suturing the first

skin incision completely and applying the ordinary dressings. Care must be taken to see that neither the opening into the abdomen nor the second opening through the skin is narrow enough to constrict the portion of stomach passing through it.

After-treatment.—The stomach is not opened immediately, and 24 or 48 hours should be allowed to elapse if possible before the opening is made. The best way of opening the stomach is to cut through the serous and muscular coats with a knife between the two guiding stitches until the mucous membrane is reached. This is easily ascertained, as the protruded portion of the stomach becomes stiff from inflammatory exudation and the contrast between the muscular walls and the yielding mucous membrane is very marked. The latter is now picked up in forceps and snipped through with scissors, when a little gastric juice escapes and renders it certain that the cavity has been opened. The opening is then slightly enlarged with scissors and a No. 12 or 14 catheter is introduced in the direction of the track, slightly from left to right, and a meal administered. It is very inadvisable to attempt to open the stomach by thrusting in a trochar or by cutting across with a knife, as the mucous membrane always slips out of the way and it must be identified and divided separately. The catheter should be fastened in position until about the fourth day, when the adhesions will be quite firm and it may safely be left out and merely passed each time for feeding purposes. The dressing over the original median incision should be changed at the time that the opening is made into the stomach and covered by a small dressing freely varnished over with collodion so that the discharge from the stomach will not affect it. As a matter of fact, it is almost invariable for primary union to occur in this wound. In the intervals between the feeding, the patient should wear a well-fitting abdominal bandage with a pad of salicylic wool over the opening. The pressure of the bandage acts upon the portion of the stomach wall which is bent at right angles in two places, and is quite sufficient to prevent leakage of the gastric contents.

If the patient be very feeble at the time of the operation, it may be desirable to introduce food immediately, and this can be done quite safely in this operation by puncturing the stomach wall obliquely in the neighbourhood of the proposed opening with an aspirating needle and administering through it a meal of peptonised milk. A few drops of boracic lotion are syringed through the needle after the meal has been introduced, so as to cleanse the tube, which is then withdrawn and the operation is proceeded with. If it be thought advisable to feed the patient in this manner, it should always be done when the stomach is pulled out through the abdominal wound and before it is carried beneath the soft tissues to the second opening as, if delayed until that stage of the operation, there would be a difficulty in finding the way into the stomach and the attempt would be very likely to end in the food being introduced into the peritoneal cavity or between the mucous and muscular coats.

Relative merits of the operations.— *Witzel's operation* is suited for all cases in which gastrostomy can be performed, and it provides a most effectual safeguard against regurgitation of the stomach contents. It also has the advantage that the patient is or can be fed immediately from the time of operation. It possesses the disadvantages that it perhaps requires a longer time for its performance, that it necessitates very careful suturing in the formation of the stomach tube and that it involves the patient wearing the tube for some considerable time after the operation, as otherwise the artificial opening tends to close. Another possible disadvantage is that in inexperienced hands the suture may be faulty and leakage may take place between the stomach and the abdominal wall, and suppuration and possibly fatal peritonitis may occur.

Franck's operation has the advantage that in suitable cases it is very easy, that it can be done rapidly and that under no circumstances should there be any septic infection following it. A not inconsiderable advantage is the fact that no tube need be worn after the fourth day. It has the disadvantage that it cannot be performed in cases in which the stomach is either greatly contracted—as in advanced cases of starvation from œsophageal stricture—or where the stomach is fixed by cancerous infiltration so that it cannot be pulled out of the wound; this may be the case in extensive cancerous stricture about the cardiac end of the œsophagus. Two other possible disadvantages, namely, difficulty in opening the stomach after the operation and in feeding the patient immediately, should not occur if the recommendations given above be followed. Although we have had no experience of this, it is possible that a further disadvantage may be that, should the patient live long, the passage from the stomach to the skin may in the course of time become more or less straightened from the downward pull of the organ, and so allow regurgitation.

CHAPTER XIV.

GASTRIC ULCER.

Simple ulcer of the stomach is a very common affection, and occurs twice as frequently in women as in men. The usual age is between twenty and forty in women, in men the average is ten years later; it may however occur up to a very advanced period of life. The ulcer is most common upon the posterior wall towards the pyloric end and lesser curvature of the stomach. It is said that in not more than 5% of all the cases is the ulcer situated upon the anterior wall, but on the other hand, something like 80% of all the fatal perforations following ulcer occur in that situation. As a rule the ulcer is single; sometimes it is multiple, though very rarely more than two co-exist, and sometimes an ulcer occurs in the duodenum as well as in the stomach. The ulcer itself is usually round or oval, but it may be irregular in outline, either from extension of the original ulcer or from the confluence of isolated ones. The edges are quite clean-cut, and the ulceration may only involve the superficial portion of the mucous membrane, or the submucous and muscular coats may be entirely destroyed. There is no constant relation between the depth of the ulcer and its size; a very small ulcer may penetrate very deeply and *vice versâ*. When the ulcer is of recent development, the stomach walls in its immediate vicinity are not much altered; when, however, it has lasted for a long time, there will be extensive induration, giving rise to characters often mistaken for malignant growth. The rest of the stomach is usually normal except that the pylorus is unduly firmly contracted.

RESULTS.—An ulcer of any long standing usually gives rise to various important sequelæ, and it is chiefly in connection with these that the surgeon is called in. The following are the principal ones:

1. **Hæmorrhage.**—As the ulceration deepens, one of the larger vessels may be opened and hæmorrhage, which may be capillary, venous, or arterial in nature, will result; as a rule the latter is rare, but sometimes a large artery may be ulcerated into, as, for example, in ulcers situated near the lesser curvature of the stomach or in the neighbourhood of the pancreas,

and then the bleeding may be so severe as to jeopardise the patient's life in a very short time. In the more frequent forms of hæmorrhage the bleeding is not so severe and generally ceases spontaneously before a fatal result is produced; the risk is then rather from the production of profound anæmia due to the repeated bleedings. The blood so poured out may of course be vomited or it may be passed by the bowel; in the latter case it generally is an indication that the bleeding is extensive, as in slight cases the blood may become digested and absorbed.

2. Interference with the gastric functions by the contractions accompanying healing.—When a gastric ulcer heals, or attempts to heal, the tissues around become indurated, as in ulcers elsewhere, and the scar contracts. The gastric wall consequently becomes thickened, and its cavity may be markedly distorted by the subsequent contraction. This excessive thickening, which of course passes off to a considerable extent when the ulcer has actually healed, but which is very marked while the ulcer still exists and has lasted for a long time, may be so great as to give rise to the suspicion of a tumour and, even after the stomach has been exposed, it may still be doubtful whether the case is one of ulcer or of malignant tumour.

Apart from this thickening of the stomach walls, which is by no means a constant occurrence, a certain amount of contraction always follows healing of the ulcer, and it depends upon the position and extent of the latter whether this contraction reaches such an extent as to interfere with the functions of the stomach. When the ulcer is situated in the neighbourhood of the pyloric orifice and is of any size, the contraction during healing narrows the pylorus and interferes with the free passage through it. Stenosis of the pylorus is produced and may progress to such an extent as to obliterate it almost completely. The stomach in consequence becomes dilated and, in addition to the already existing symptoms of the gastric ulcer, there are those special to the dilated organ.

3. Dilatation of the stomach.—This is a frequent accompaniment of gastric ulcer at some period of its course. It may be due essentially to pyloric obstruction, which in the slightest cases may arise from the spasm of that structure that is so common an accompaniment of an ulcer situated anywhere in the stomach, but which is far more frequently caused by actual cicatricial narrowing from the contraction of an ulcer in its vicinity, or by adhesions external to the organ resulting from perigastritis. It is also said that the stomach may dilate from atony of its muscular walls. The dilatation of the stomach is of course a mere symptom of obstruction to the passage of food.

4. Perigastritis.—As the ulcer deepens, the peritoneal coat of the stomach covering its base becomes inflamed and adhesions occur between the stomach and neighbouring structures, or bands of inflammatory tissue form upon the surface and during healing will interfere with the functions of the organ by their contraction. This so-called perigastritis is very frequent

in ulcers that have extended deeply and is of great functional importance, partly because it interferes with the movements of the organ and partly because it acts beneficially to a certain extent in affording some protection against perforation.

The exact effects of perigastritis will depend upon the situation of the ulcer; thus, when the latter is situated in some portion of the stomach in close proximity to other organs, adhesions will occur, whilst on the anterior surface cicatricial bands are likely to form. The most frequent seat of adhesions is about the pylorus, which becomes connected with the under surface of the liver, the gall bladder, or the bile duct, and may thereby become so distorted that the passage of the gastric contents through it is greatly interfered with. Similarly, an ulcer on the posterior surface of the stomach causes the organ to become adherent to the pancreas. Adhesions may also occur between the stomach and the omentum, the transverse colon or the diaphragm. Adhesions are least liable to occur when the ulcer is on the anterior surface and this is the explanation of the fact that ulcers in that situation are the most common cause of fatal perforation.

In extensive ulcers on the anterior surface of the stomach the perigastritis will cause much distortion of the viscus as healing occurs, from contraction of the inflammatory material upon the peritoneal surface. This in certain cases may give rise to a constriction passing from one border of the stomach to the other and producing the so-called "hour-glass contraction," in which the stomach is marked off into two cavities with a passage of varying calibre between them. The cardiac portion of the stomach under these circumstances may dilate to such an extent that the condition may not be accurately diagnosed, the case looking like one of contraction of the pylorus rather than an hour-glass contraction of the stomach. Some authors limit the term hour-glass contraction to its strict meaning, namely, a constriction situated exactly in the centre of the stomach; but it is more convenient from the point of view of treatment to enlarge the term so as to embrace all contractions of the stomach which produce a circular narrowing of the cavity and divide it into two sacs, even though these be of very unequal size.

5. Perforation.—This is a not uncommon accompaniment of gastric ulcer and may give rise to various results. When the ulcer perforates the stomach wall and there are no adhesions, so that the gastric contents are extravasated freely into the general peritoneal cavity, a fatal septic general peritonitis is set up; on the other hand, if perforation occurs in a situation where more or less extensive adhesions have already occurred, the extravasation of the stomach contents may not take place into the general peritoneal cavity and localised suppurative peritonitis followed by abscess may form. Lastly, the entire thickness of the stomach wall may be destroyed by the ulcer without the occurrence of either peritonitis or suppuration when the perigastritis has produced firm adhesions between the stomach wall and the neighbouring tissues. This is common in the neighbourhood of the pancreas.

PATHOLOGY.—The pathology of gastric ulcer is by no means clear. It is probable that the ulceration is preceded by thrombosis of the smaller vessels and that the ulcer is a necrotic process following this. It is very common in anæmic girls and it is probable that the anæmia may have something to do with the production of the ulcer. It has also been suggested that the ulcer is caused by some slight injury to the mucous membrane, but in operating upon the stomach the mucous membrane may be freely divided without an ulcer being produced. Hyper-acidity of the gastric contents has also been assigned as a cause, but this explanation is not satisfactory, as hyper-acidity is frequently met with unaccompanied by ulcer.

Whatever may be the pathology of the condition, the important point in the treatment of the actual ulcer itself, apart from its sequelæ, is the fact that healing is greatly hindered by the state of unrest caused by the constant passage of food over the raw surface; the stomach must therefore be given more or less complete rest.

SYMPTOMS.—Although the symptoms of this affection are well known, and the diagnosis is usually easy, it has happened more than once that the stomach has been cut down upon under the impression that an ulcer was present or even that perforation had occurred, and nothing of the kind has been found. The subjects of gastric ulcer are usually anæmic, thin and with a poor appetite, and complain of three principal symptoms, viz., pain, vomiting and hæmatemesis.

Pain in well-marked cases is constant and of varying intensity. The exact period at which it supervenes after food varies to some extent with the position of the ulcer; when this is situated near the cardiac end of the stomach pain usually occurs immediately after food; when at or near the pylorus it may not come on for as long as an hour or two after a meal. An important diagnostic point is that the pain is increased by pressure. In very neurotic subjects who are not suffering from ulcer it is not uncommon to have pain after food complained of, but this is usually relieved by pressure. The pain due to gastric ulcer is generally relieved by lying down, and some slight help in diagnosing the situation of the ulcer may be obtained by noticing the position of greatest ease; for example, if the dorsal position be most comfortable, the probability is that the ulcer is situated on the anterior wall of the stomach; if lying on the right side gives most ease, it is probable that the ulcer is near the cardiac end and *vice versâ*. The pain complained of is usually about the middle line and very often extends through from the xiphoid cartilage to a spot on the left of the last dorsal vertebra. When the ulcer is on the anterior wall there is marked tenderness in the epigastrium; when on the posterior surface, the tender spot is to the left of the last dorsal spine.

Vomiting very commonly occurs at some time in the course of a gastric ulcer, but its diagnostic importance is comparatively slight as it occurs so frequently in many other affections. It generally sets in some considerable time after food, but may be entirely absent. It is most characteristic of

course when the stomach has undergone dilatation and then it forms one of the symptoms of dilated stomach, large quantities of food being vomited at irregular and infrequent intervals, often in a state of decomposition and undergoing yeasty fermentation.

Bleeding is the only certain sign of ulcer of the stomach, but it may be entirely absent. When it is slight it comes from superficial ulcers involving the smaller vessels, and the trouble arises more from the anæmia produced by the constant recurrence of the bleeding than from the actual loss of blood at any given time. In other cases the hæmorrhage is very grave, as the ulceration opens one of the larger vessels and the patient may actually die from loss of blood, although this is very rare. Hæmorrhage from the stomach may of course occur in malignant disease and in other conditions such as cirrhosis of the liver, which will be found referred to in medical text-books, but the occurrence of occasional attacks of hæmorrhage from the stomach, which are sometimes severe and are accompanied by pain and vomiting in a young chlorotic woman, is almost pathognomonic of a gastric ulcer.

Hyper-acidity of the gastric contents due to an excess of free hydrochloric acid, is an almost constant feature in the affection but is not diagnostic in itself.

TREATMENT.—In the early stages of the disease the treatment is essentially a matter for the physician, but of late years surgical intervention has been practised in an increasing number of cases and often with the greatest benefit. We may summarise the chief circumstances under which the surgeon may be called in:

1. When the symptoms are long-continued and do not yield readily to medical treatment, particularly when profound anæmia is resulting from the repeated hæmorrhages.

2. To arrest profuse hæmorrhage that threatens life.

3. To relieve constriction of the pylorus or an hour-glass contraction of the body of the organ and so to cure a dilated stomach.

4. When perforation of the ulcer into the peritoneal cavity has occurred.

5. To relieve various indefinite symptoms, not necessarily caused by the actual existence of the ulcer but following the healing of one. These symptoms are generally due to adhesions which either alter the direction of the pylorus, constrict the stomach or tether down the organ to adjacent structures.

6. To open and treat a sub-phrenic abscess.

TREATMENT OF CASES ACCOMPANIED BY PROFOUND AND INCREASING ANÆMIA.

These are practically the only cases in which surgical treatment is required for the ulcer *per se*, and interference should not be practised except when the condition threatens the patient's life or makes it unen-

durable from intense or persistent pain or profound malnutrition; it will be undertaken more readily in those who have to earn their living and cannot devote the time necessary for thorough medical treatment.

Medical treatment.—We need not go into the medical treatment beyond remarking that its primary objects are two in number: (*a*) to give physiological rest to the stomach, and (*b*) to administer remedies calculated to promote healing of the ulcer. In the acute stage the patient should be confined to bed, and movement must be restricted as far as possible. The intense pain is best relieved by large hot *fomentations* over the epigastrium and left side of the abdomen. This pain may be so severe that hypodermic injections of morphine may be necessary, and this drug is also sometimes useful as it checks the vomiting.

Various sedative *drugs* may be administered by the mouth, of which bismuth, hydrocyanic acid and morphine are the chief. The following prescriptions may be used with advantage:

℞ Liq. Morph. Hydrochlor.	♏ x.	℞ Bismuth Carb.	gr. xv.
Bismuth. Carb.	gr. xv.	Sodii Bicarb.	gr. xx.
Sodii Bicarb.	āā gr. x.	Acid Hydrocyanic. Dil.	♏ iij.
Pulv. Tragacanth Co.		Æther. Chlor.	♏ xv.
Spirit. Chlorof.	♏ x.	Aquam ad	℥i. tds.
Aq. Menth. Pip.	ad ℥i. 4tis horis.		

It is advisable also to administer some saline aperient, such as Carlsbad or other waters, occasionally.

Rectal alimentation.—All nourishment should at first be given *per rectum*, in the form of nutrient enemata, and should be accompanied by a large injection of normal saline solution once or twice daily. If the latter do not check the thirst, the patient may be allowed to suck a little ice.

Dr. Otto Grünbaum, Clinical Pathologist to King's College Hospital, has been kind enough to furnish us with the following points relative to this important question of rectal feeding:

> "Since the rectal injections often replace not only the solid but also the liquid part of the diet, they should consist of water, proteïds, carbohydrates and fats. If sufficient water cannot be absorbed by the large intestine and none may be given by the mouth, subcutaneous injections of sterile normal salt solution must be resorted to.
>
> "Before beginning rectal feeding the lower bowel should be emptied and cleansed by the administration of a copious warm water injection; at least an hour must then elapse before the nutrient enema is introduced.
>
> "The best position for the patient is lying on the left side with the pelvis slightly raised on a pillow placed under the hips. A long soft rubber œsophageal tube is greased (glycerine must not be used) and carefully passed from six to twelve inches into the bowel; to the end of the tube a glass funnel is attached, and into it the enema warmed to 99° F. is poured. For the first ten minutes after the introduction of the enema the nates should be pressed together with a towel, and the patient ought to remain undisturbed for an hour.
>
> "The pressure under which the fluid is introduced should not exceed that due to a column of water three feet high; the fluid, flowing in slowly, finds its

way into the sigmoid flexure and the descending colon, and therefore does not excite the desire to evacuate. This avoidable complication is often due to a sudden distension of the rectum which usually occurs if the injection be shot into the bowel with a syringe.

"The volume and exact composition of the enema must depend upon the state of the mucous membrane of the large intestine. It is generally desirable to introduce at least two and a half ounces (80 grams) of proteid, three and a half ounces (100 grams) of carbohydrate, and five drachms (20 grams) of fat per diem. This, if completely absorbed, would represent half of the energy required by a patient lying in bed in a room at 62° F.

"The constituents of the enema must be unirritating and easily absorbed; the following have been used with success and are usually retained without trouble:

Whites of three eggs.	Albumose,[1] ℥ ij.	Ox-serum, ℥ v.
Milk, ℥ iv.	Milk, ℥ vij.	Milk, ℥ ij.
Starch (raw), ℥ j.		Glucose or Starch, ℥ vj.
Salt ℥ ss.		
Sextis horis.	Sextis horis.	Sextis horis.

"Occasionally it is found that the addition of a few minims of liquor pancreaticus improves absorption, but this preparation must not be added to an enema containing more than 10% of starch, lest the mucous membrane be irritated by the strong solution of sugar which would be rapidly formed. The proteids in eggs and milk are not so readily absorbed as those in serum, but the latter has been known on rare occasions to give rise to slight urticaria. The prolonged administration of albumoses may lead to colitis.

"Nutrient enemata must not be stopped if the first few be returned; a tolerance is often established after two or three have been given. If however tolerance be not established, an ounce of red wine added to the enema has frequently been found to produce the desired result.

"If no formula proves satisfactory, even when only three ounces be introduced at a time, recourse must be had to a small boiled starch enema (one ounce) containing 10 to 20 minims of tincture of opium followed an hour later by a nutrient injection.

"The rectum must be washed out daily with a warm water enema. Nutrient suppositories cannot be recommended, for, even if they were absorbed, more than sixty would be required daily to supply the necessary energy.

"At present we do not know how to prepare fat in a way that permits of its being absorbed in sufficient quantity by the large intestine; this difficulty may be partially overcome by injecting an ounce or two of sterile olive oil into the subcutaneous tissue of the groin every second day. No untoward effects follow this procedure, while the food thus introduced is utilised and materially diminishes the fall in the weight of the patient."

Surgical treatment.—The indications for surgical interference have already been given (see p. 233) and the measures employed will aim at removal of the ulcer, at putting the stomach at rest, or at both combined. The second condition may be brought about surgically either by enlarging the existing pyloric opening, which may be either mechanically or spasmodically contracted, or by the formation of a new and efficient communication between the stomach and the intestine (gastro-enterostomy) so as to prevent fluids being retained in the stomach where they will undergo decomposition and irritate the ulcer both chemically and mechanically.

[1] "Somatose" and Heyden's "Nährstoff" consist chiefly of albumose.

Of these two surgical principles the second is the one of more general application. Excision of the ulcer itself followed by suture of the stomach wall, although theoretically the better procedure, is disappointing in practice. In the first place, a very large proportion of the ulcers are so situated that excision is out of the question; in the second, such a procedure may mean a very extensive operation which has to be carried out in a subject unable to bear it; finally, the wound made by the excision of the ulcer may fail to heal and another ulcer may be substituted for the one excised, or a fresh one may develop independently elsewhere, as the hyper-acidity of the stomach contents and the spasm of the pylorus are not affected by the operation and the original cause of the ulcer therefore probably still remains. At the same time, when the ulcer is easily reached and is small, it is clearly good treatment to excise it, but this operation should always be supplemented by either pyloroplasty or gastro-enterostomy, so as to provide for the free escape of the stomach contents and to enable the organ to get rest. The ulcers best suited for this method of treatment are those found on the anterior wall of the stomach; in them the opening left by excising the ulcer may be utilised in performing gastro-enterostomy.

Excision of a gastric ulcer.—In all cases the stomach should be carefully emptied and washed out before operation so as to get rid of decomposing material, to avoid the risk of vomiting under the anæsthetic and to diminish the risk of the escape of the gastric contents when the ulcer is excised.

The abdomen is opened by the usual vertical incision a little to the left of the middle line (see p. 188) and the anterior wall of the stomach is exposed. If the ulcer be situated upon it, the operation is extremely easy as the ulcer can be felt through the wall and its presence is evident to the eye by the thickening of the peritoneal coat of the stomach over it. The stomach is drawn well out of the wound and packed off with abdominal cloths (see p. 177); the entire organ should be pulled out or at any rate enough of it to render the necessary manipulations easy. The ulcer is then excised by enclosing its base in an elliptical incision, which should if possible have its long axis at right angles to that of the stomach. This will divide fewer vessels and at the same time will not diminish the transverse diameter of the organ when sewn up. As the incision into the stomach is being made, the assistant presses together the stomach walls well below the ulcer and raises it so as to constrict it and prevent the escape of the gastric contents. The ulcer should be excised rapidly and the edges of the incision are then seized in catch forceps and still further raised by the assistant; this should entirely prevent the contents from escaping. As a rule the bleeding following excision is not very severe; it is greatest when the ulcer lies near either of the curvatures as one of the larger vessels may then be cut across. It is however comparatively easy to seize any spurting vessel and the bleeding may always be stopped, temporarily at any rate, by compressing the edge of the incision between the finger and thumb. Any

oozing that remains is easily checked by sewing up the stomach and this is done precisely as in the operation for rupture of the stomach (see p. 212); the steps of the procedure will be found described in full there and need not be recapitulated here.

Should the area of the stomach excised be considerable, there may be some tension on the edges of the wound and under these circumstances it will be best to make the deep layer of Halsted's sutures (see Fig. 51) and to bury these by a superficial continuous Lembert suture. In an organ like the stomach where the parts are easily accessible, it will be found that the sutures, particularly Halsted's, are more readily inserted by using a straight spring-eyed needle which requires no needle-holder than the small curved Hagedorn needles for which of course a needle-holder is necessary.

It is most important—more particularly perhaps in the case of the intestines—to see that no constriction of the lumen of the organ can occur as a result of suturing wounds of this sort; for example, if the vertical measurement of the portion excised from the anterior wall of the stomach be comparatively large, the distance between the two curvatures may be much diminished if the opening be sewn up so as to leave a horizontal cicatrix, and a condition somewhat approaching an hour-glass contraction may be produced by the operation. This is easily avoided by suturing the wound so as to make the scar vertical (see Fig. 58); this may actually increase the vertical measurement so that, even allowing for some contraction subsequently, the capacity of the viscus will not be diminished.

It is very seldom however that mere excision of the ulcer suffices for a cure, because the pylorus is either spasmodically or organically contracted and none of the causes of the original ulcer, namely the hyper-acidity of the stomach and the difficulty of the passage of the stomach contents, are remedied. We therefore do not advise its being relied upon alone, and are of opinion that, after the ulcer has been thus disposed of, if in an accessible situation, the surgeon should proceed to perform either gastro-enterostomy or pyloroplasty—the former for preference. Practically the only exception to this rule will occur in the case of an ulcer actually at or in the immediate vicinity of the pylorus which is not adherent to the surrounding structures; here excision of the ulcer alone will suffice as it is practically a combined excision of the ulcer and of the pylorus.

As a rule however neither operation is available in these cases. In active ulcers situated near the pylorus this structure is so fixed by adhesions that excision of the ulcer is not only difficult to perform, but subsequent kinking of the pylorus and reproduction of the obstruction are very likely to occur. When the infiltration with inflammatory products is very great it is practically impossible to bring the edges of the incision in the pylorus together and pyloroplasty is not feasible. Lastly, when an ulcer in this situation has lasted for a very long time, the stomach may have

so little contractile power left that it is unable to drive its contents through the artificially enlarged pyloric opening.

On the other hand, gastro-enterostomy may be performed at any suitable portion of the stomach and allows free escape of the stomach contents

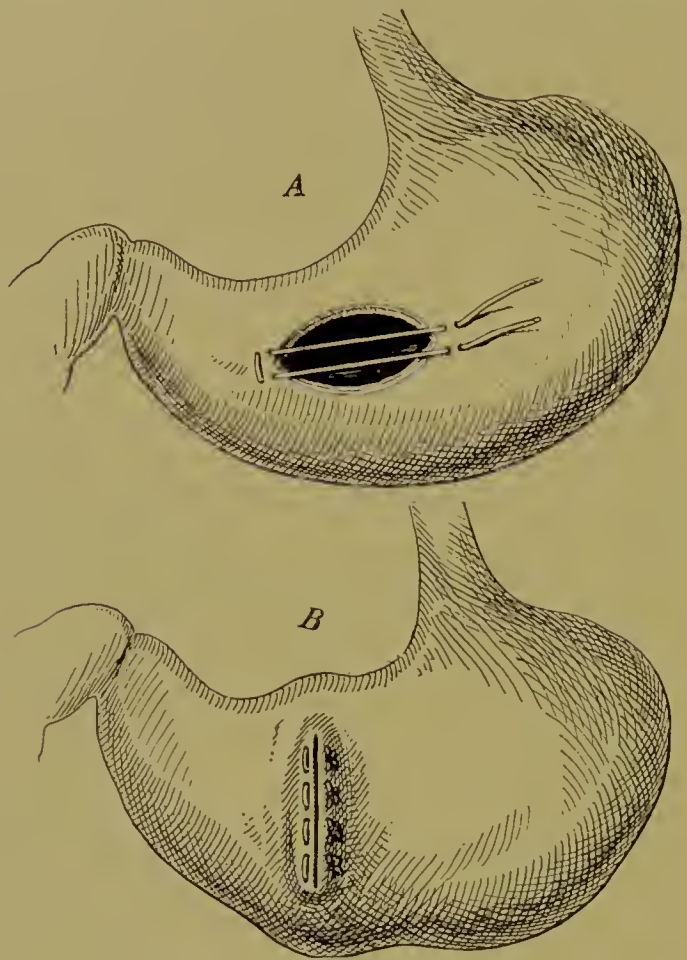


FIG. 58.—METHOD OF PREVENTING NARROWING OF THE STOMACH AFTER EXCISION OF A LARGE GASTRIC ULCER. This is practically identical with gastroplasty. *A* shows the method of converting an ellipse with its long axis parallel to the curvature of the stomach into an opening with its long diameter at right angles to this. The suture is Halsted's. In *B* the row of sutures is inserted preparatory to being buried by a continuous Lembert stitch.

even though the contractile power of the gastric walls be deficient. It is not really a very severe operation and it may have the great additional advantage that in certain situations the ulcer may be excised and the opening left may be utilised for the gastro-enterostomy. We shall describe both pyloroplasty and gastro-enterostomy.

Pyloroplasty.—We should limit this operation to cases of dilatation of the stomach due to a narrowing of the pylorus unaccompanied by many adhesions or undue thickening of its walls and without any marked atony of the stomach. The principle of the operation is to make a free longitudinal incision from the stomach to the duodenum, dividing the pylorus along its long axis, and then to approximate the two ends of this incision so as to convert it into a transverse one, thereby increasing the diameter of the

pyloric ring (see Fig. 59). The abdomen is opened slightly to the right of the middle line in the usual manner (see p. 188) and the pylorus brought as far up into the wound as possible and packed off with abdominal cloths (see p. 177). If the parts be not sufficiently movable, the operation must be performed within the abdomen, but if the stomach be much dilated and there be little infiltration about the pylorus they may be got well outside. A clamp, such as Lane's (see Fig. 60), is applied to the duodenum

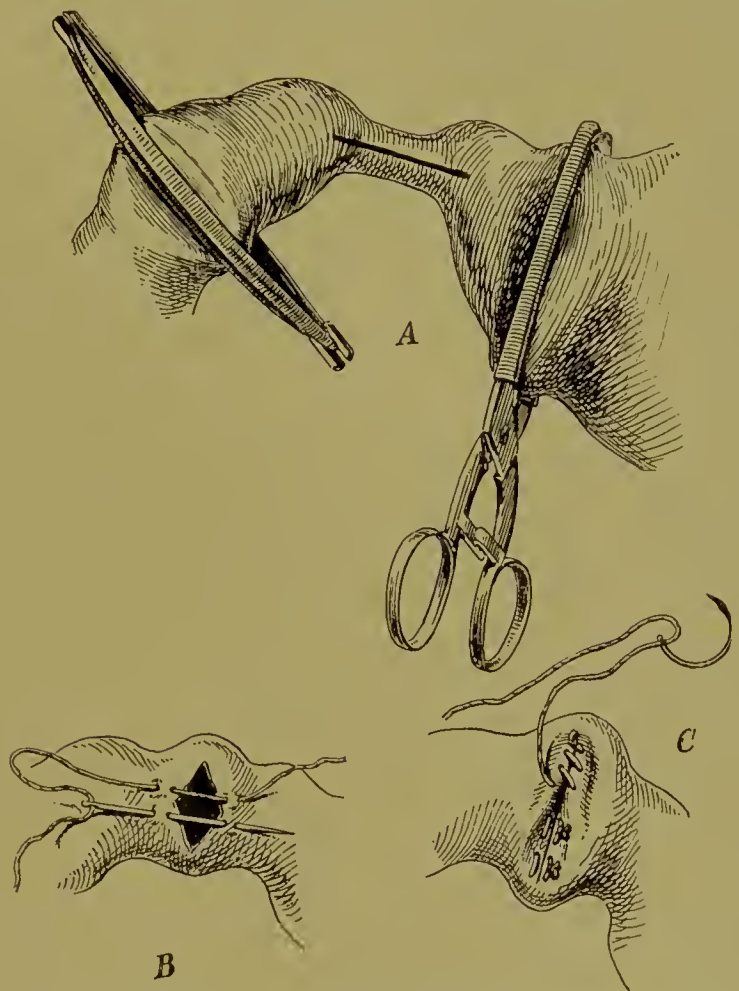


FIG. 59.—PYLOROPLASTY. In *A* is shown the method of clamping the bowel by a Lane's clamp (see Fig. 60) on the left-hand, and the stomach by rubber-sheathed forceps on the right-hand side. The longitudinal incision is marked out along the narrowed pylorus. In *B* this incision is converted into one that has its long axis at right angles to that of the pylorus by a Halsted's suture. In *C* the row of Halsted's sutures is in place and is being buried by the continuous sero-muscular stitch. The calibre of the pylorus is relatively much enlarged.

as far on the distal side of the proposed incision as possible, the loop of bowel being squeezed empty of its contents before it is applied. The pyloric end of the stomach should also be clamped with suitable clamp forceps (see Fig. 59, *A*) the blades of which are covered with india-rubber tubing. The whole area around is packed off carefully with abdominal cloths, and an incision is made in the anterior wall of the stomach, about half an inch from the pylorus, and carried horizontally through that

structure reaching about half an inch along the duodenum. If there be much contraction it may be difficult to hit off the passage through the pylorus, and it is then best to commence by opening the stomach just in front of the pylorus and then to pass a probe through the latter into the duodenum and cut down upon this as a guide; if preferred, a pair of probe-pointed scissors may be used to slit up the pylorus. One of Halsted's mattress sutures (see p. 215) is then inserted at each end of



FIG. 60.—LANE'S INTESTINAL CLAMP. The lower figure shows the clamp as in use. It is seen applied to the intestine in Fig. 59. The rod is made to transfix the mesentery and under-run the bowel, while the india-rubber bands pass over the latter and so compress its lumen.

this incision, and when this is tied, what were formerly the terminations of the incision become the central points and the opening is converted from a longitudinal into a transverse one (see Fig. 59, *B*). This suture should be of silk and should be reinforced by two others on each side, so that the edges of the incision are brought together throughout; the operation is completed by burying these sutures with a continuous stitch of fine catgut outside, so as to prevent any leakage (see Fig. 59, *C*). The area of operation is then carefully cleansed, the abdominal cloths are removed and the abdomen closed in the usual manner (see p. 189).

Gastro-enterostomy.—The operation that we advocate for chronic ulcer of the stomach, whether the ulcer has been previously removed or not, is gastro-enterostomy, by which is meant the formation of a permanent artificial opening between the stomach and the small intestine. The operation is usually termed gastro-enterostomy, but it is more correct to call it either gastro-duodenostomy or gastro-jejunostomy, according as the portion of small intestine selected for the anastomosis forms part of the duodenum or the jejunum. It is very rarely indeed that it is necessary to anastomose the ileum to the stomach. The operation that is practically always performed is gastro-jejunostomy, gastro-duodenostomy being only employed after a pylorectomy has been performed. This is referred to later (see Chap. XV.). There are two chief methods of performing gastro-jejunostomy which are called the anterior and posterior methods according as the bowel is attached to the anterior or the posterior surface of the stomach. The anterior form is again subdivided into the pre- and post-colic forms, in the former of which the loop of jejunum is brought up around the lower edge of the omentum in front of the transverse colon and attached to the anterior surface of the stomach, while in the latter the transverse meso-colon and the omentum are perforated and the

loop of the jejunum is drawn through the slit thus made in order to be attached to the anterior wall of the stomach. Fig. 61 indicates diagrammatically the principle of these operations.

Advantages of the different methods.—Both the anterior and posterior operations are suitable in certain cases and both present certain disadvantages. We may, however, at once dismiss the retro-colic variety of the anterior form of gastro-jejunostomy as being on the whole unreliable and not to be recommended at all, as strangulation of the jejunum is very apt to occur at the aperture through which the loop has to pass in order to reach the anterior surface of the stomach; if this aperture be made sufficiently large to avoid all possible danger of strangulation there is a risk of interfering with the vascular supply in the meso-colon.

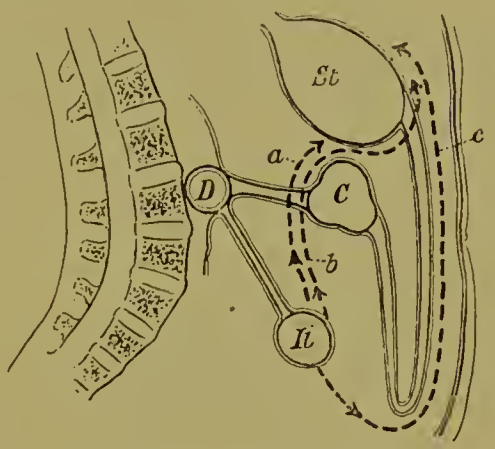


FIG. 61.—DIAGRAM ILLUSTRATING THE VARIOUS METHODS OF PERFORMING GASTRO-ENTEROSTOMY. The dotted lines indicate the direction in which the small intestine (*Il*) is carried. Thus *a* is the posterior gastro-enterostomy, *b* is the retro-colic, and *c* the ordinary or pre-colic form of anterior gastro-enterostomy. *St*=stomach. *D*=duodenum.

The anterior operation is the easier one to perform and is the natural one when an ulcer has been excised from the anterior wall of the stomach. It is also specially suited for cases in which the ulcer is extensive and situated on the posterior wall, which is bound down to the pancreas or the surrounding tissues, and where therefore the posterior operation is not practicable. Another great advantage, especially to beginners, is that the entire operation can be carried out outside the abdomen and therefore there is little risk of soiling the peritoneum; there is practically no likelihood of the stomach contents escaping when the opening is made, as the assistant can hold up the lips of the incision.

The posterior form, although open to the objection that it is more difficult to perform and that the operation has to be done deeper down in the abdomen and that it is therefore less easy to prevent the escape of the stomach contents when the opening is made, is nevertheless superior to the anterior form in many points. In the first place it opens the stomach in a dependent situation and so allows free escape of the gastric contents. It is also quite easy in this operation to be certain that the right portion of the bowel is selected for anastomosis and as little as possible of the intestinal canal is cut off from the circulation, although this is probably not a point of any great importance. It is said by some that the establishment of the "vicious circle" (see p. 243) is seen more often in the anterior than in the posterior form of the operation; in the latter there is certainly less risk of kinking of the bowel as it leaves the artificial opening than in the anterior form. In a posterior gastro-enterostomy it is impos-

sible to apply the intestine in the wrong direction over the stomach, viz. so that peristalsis runs from right to left instead of from left to right; this of course is very important as, if the peristaltic wave in the stomach and the small intestine be in opposite directions, the intestinal contents will be forced into the upper part of the jejunum and the duodenum which become dilated and thus a vicious circle is formed. This should not happen in either operation, but is more likely in the anterior form from mistaking the coil of bowel. There is another possible risk connected with the anterior operation which is not present in the posterior. It is that, when the jejunum is brought round the omentum in front of the transverse colon, the latter organ

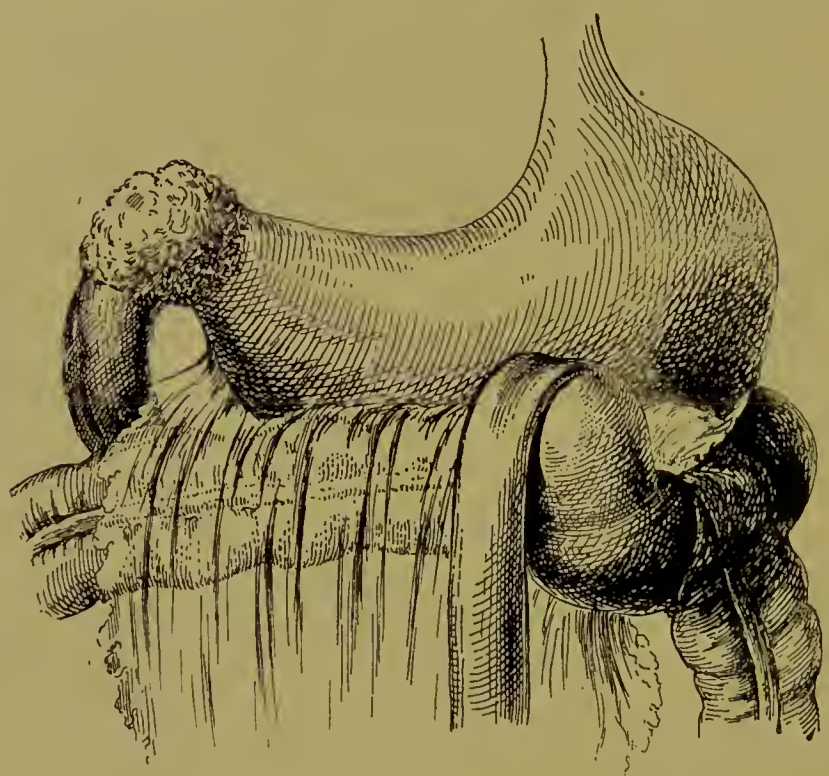


FIG. 62.—DIAGRAMMATIC SKETCH OF A FAULTY ANTERIOR GASTRO-ENTEROSTOMY. This illustrates two defects that may accompany the anterior form of the operation, viz. compression of the colon by an unduly short loop of jejunum, and the formation of the "vicious circle." The latter is due to the kinking at the anastomotic opening; the dilated coil of jejunum between the pylorus and the opening is well shown.

is apt to be pressed on injuriously by the jejunum (see Fig. 62), and, conversely, the jejunum may be compressed by the colon unless care be taken to have a sufficient length intervening between the third part of the duodenum and the anastomotic opening; even though this be sufficient at the time of the operation, pressure may occur later as the patient gets stouter and the omentum fills with fat. This of course can be guarded against by allowing at least two feet to intervene, but the mistake has certainly happened. Hence we prefer the posterior form whenever it can be done and whenever the patient's strength suffices for a somewhat longer operation. We reserve the anterior form for cases in which time is of great importance, in which the posterior surface of the stomach is so fixed that it cannot be

properly got at, and the rarer cases in which there is an ulcer on the anterior surface the excision of which will furnish one of the openings for the anastomosis.

In the majority of cases we prefer to make the junction between the stomach and intestine by a process of simple suture and we shall therefore describe this first as it is certainly the safest and most accurate method that can be employed, for by it the surgeon can make an opening of any size that is convenient. It undoubtedly requires a longer time for its performance however than most of the operations that are facilitated by such mechanical appliances as Mayo Robson's bone bobbins or Murphy's button, the use of which we do not advocate except in cases of emergency. These methods will be described afterwards (see p. 259 *et seq.*).

Before proceeding to describe the steps of the operation there are certain absolutely essential precautions that require mention if gastro-enterostomy is to be successfully performed. There is no doubt that in the past considerable mortality has attached to this operation, which we think is largely due to the neglect of the precautions that will be indicated. This mortality is steadily decreasing with a better technique, but the operation cannot yet be said to be free from a fair amount of risk, and therefore the most careful attention should be paid to any point that will lead to its improvement.

The "vicious circle."—If for any reason the contents of the loop of the jejunum between the pylorus and the artificial opening be unable to find their way past the latter to the distal portion of the jejunum, what is known as the "vicious circle" is rapidly established. The contents of the duodenal loop, consisting mainly of bile and pancreatic secretion with any small portion of stomach contents that may have got past the pylorus, are projected into the stomach instead of finding their way along the intestinal canal; conversely, the contents of the stomach, instead of being entirely emptied into the distal portion of the jejunum are partially, and sometimes entirely, poured into the duodenal loop. The result of this is two-fold; on the one hand, the presence of bile in the stomach excites vomiting of a most intractable character; on the other, there is extreme dilatation of the portion of intestine between the pylorus and the anastomosis (see Fig. 62). There can be no doubt that the establishment of this vicious circle is at the present time practically the main cause of the mortality following gastro-enterostomy, and it is to the avoidance of this that the surgeon's chief attention must be directed, as, when once thoroughly developed, it proves fatal, usually within a fortnight from the time of the operation, as a result of the persistent vomiting that ensues. The existence of the condition may be suspected if the patient vomits persistently after the second or third day without any signs of peritonitis being present; this suspicion is still further confirmed if the vomit contain large quantities of bile. Vomiting earlier than the second or third day may of course be due to the anæsthetic.

The causes of the condition are various. The most common is the formation of a spur in the intestine at the site of anastomosis which serves to guide the bile, etc., into the stomach and prevents it passing along the intestinal tract. The same spur makes it easier for the stomach to expel its contents into the duodenum than along the ileum. The dilatation of the duodenal loop that follows this backward propulsion of the stomach contents still further displaces the spur, so that it may ultimately act as a valve and completely occlude the efferent loop. Occasionally the spur may be double, and may be derived on the one hand from the kinked wall of the intestine, and on the other from the junction of the intestine with the stomach.

Another and rarer cause, and one that should never occur with ordinary care, is that the course of the peristaltic wave in the stomach and intestine is in opposite directions. In the stomach of course it runs from left to right, and it should run in the same direction in the intestinal loop; sometimes however in the anterior operation, especially when the ileum is joined to the stomach, the loop may be applied in the reverse direction. Another possible cause is that the anastomotic opening, which was at first transverse, may become more vertical, slit-like and inefficient from alteration in the position of the stomach and intestine. This condition however generally causes recurrence of the original symptoms rather than a true vicious circle. Another cause of the affection is an unduly long loop between the pylorus and the anastomotic opening. When an interval of more than two feet is allowed to exist between these two points the weight of the loop when filled with bile and pancreatic secretion tends to cause such an acute kinking at the stomach orifice that the bile cannot find its way into the ileum.

The need for a sufficient anastomotic opening.—Although the question of the vicious circle is the one that is all-important nowadays as regards the patient's recovery from the operation, another point of the greatest practical importance is that the opening between the stomach and intestine should be sufficiently free to answer the purposes for which it is required. It must be remembered that the anastomotic opening becomes bounded by a ring of cicatricial tissue which is rigid and incapable of altering in calibre as does the normal pylorus; moreover, as is the case with all annular cicatrices, there is a constant tendency to contraction. Therefore two sets of troubles may arise: in the first place, if the opening be small further symptoms of dyspepsia and possibly dilated stomach may occur very soon, since the opening may be so small as easily to become temporarily blocked by solid food. In the second place, even if this be not the case, increasing contraction is very likely to lead to recurrence of the symptoms and many cases of this kind are known to have occurred. An additional reason for this, common to all forms of obstruction of the intestinal canal, is that, if the anastomosis be performed for dilatation of the stomach, that organ will gradually contract after the obstruction has been relieved by

the operation until it resumes its normal size, and with this contraction there must be *pari passu* some contraction of the anastomotic opening. This may diminish a previously satisfactory opening until it becomes so small that symptoms recur.

The only remedy against this danger is to make the opening extremely free at the time of the operation, and the only way in which the surgeon can be absolutely certain that he has done this is to do the operation by simple suture. If mechanical aids, such as Robson's bobbin or Murphy's button, be employed, the size of the opening is regulated by the size of the button employed, and in a gastro-enterostomy the maximum size of the opening will be the size of the largest bobbin or button that can be got into the small intestine. In most cases this is probably much too small, as only a comparatively small bobbin can be inserted into the jejunum. By simple suture, on the other hand, the surgeon can make an opening of very considerable length; the incision into the jejunum is made parallel with its long axis and along its convex border and may therefore be of any length that is desired. Moreover, the incision in the stomach is made almost horizontal and so a good large elliptical opening with its long axis almost horizontal is secured in place of a much smaller circular one. When the operation is done for a case in which the stomach is greatly dilated, the opening can be made rather abnormally large in order to counterbalance the shrinkage of the stomach that must occur subsequently. This is to our mind the very greatest safeguard against recurrence of symptoms and is one of the strongest arguments in favour of doing the operation by simple suture.

Avoidance of sepsis.—This of course is after all the point of primary importance, but we do not lay much stress upon it as it is so obviously necessary at the present time in most operations in surgery. It is certainly not to a want of proper antiseptic precautions that the mortality hitherto attaching to the operation is due; at the same time of course the surgeon must never forget that the least carelessness in these operations is very likely to end in serious, and possibly fatal, soiling of the peritoneum, and the most scrupulous care must be taken not only to pack off the field of operation from the rest of the abdominal cavity but also to avoid as far as possible any escape of the intestinal contents during the operation. This is a precaution applicable to all operations in connection with the intestines.

The operation.—Whichever of the two operations be chosen, and whatever method be employed to unite the two portions of bowel, *the preliminary steps* are identical. The stomach should be washed out before the operation; indeed, it is well, should there be much dilatation, to wash it out (see p. 200) daily for several days beforehand, and in any case it should be done immediately before the operation so as to lessen the risk of vomiting under the anæsthetic and, more particularly, of the escape of the gastric contents into the abdominal cavity during the operation. The preliminary washing out of the stomach also diminishes the post-operation vomiting.

The most suitable *anæsthetic* is chloroform; in feeble and aged persons the A.C.E. mixture may be employed, but ether should be avoided as it causes congestion of the intestines, promotes peristaltic action, and does not insure such complete relaxation of the abdominal walls as does chloroform.

The incision should be vertical, commencing above about an inch to the left of the xiphoid cartilage, and carried downwards to the neighbourhood of the umbilicus, so as to expose the stomach thoroughly. The steps of opening the abdominal cavity have already been described (see p. 188); after this all antiseptics are removed, and salt solution is substituted for them. The abdominal wound is well retracted, and the anterior surface of the stomach either spontaneously presents or is exposed by pushing down the transverse colon and the omentum. This is explored for the presence of an ulcer, which, if found, may be excised as already described (see p. 236), and the excision wound either sutured, or, if in a suitable position and of convenient size, temporarily closed by an assistant's fingers and subsequently utilised as part of an anterior gastro-enterostomy.



FIG. 63.—IDENTIFICATION OF THE JEJUNUM IN GASTRO-ENTEROSTOMY. This step is common to all the forms of the operation. The stomach and great omentum have been turned up on to the chest and covered with an abdominal cloth. The under surface of the transverse meso-colon covering the posterior surface of the stomach is fully displayed, and the fossa duodeno-jejunalis is well seen. The coil of small intestine grasped by the hand is the commencement of the jejunum.

Whether this be done or not, the next step is the *identification of the jejunum* (see Fig. 63). The omentum and the transverse colon are raised and pulled up out of the wound, and the hand is passed along the under surface of the transverse meso-colon to the left side of the spinal column. The portion of small intestine found in this situation is seized and pulled

up. If it be the jejunum, as will probably be the case, it is fixed to the side of the spine, and is thus easily identified. The further steps will depend upon whether the anterior or the posterior variety of the operation is to be performed.

Posterior gastro-enterostomy.—After the jejunum has been identified, the stomach with the great omentum and the transverse colon are pulled as far out of the abdomen as they will come and turned up upon the costal margin over an abdominal cloth and covered with another. This exposes the transverse meso-colon covering the posterior wall of the stomach. A free opening is made in the former structure over the spot at which it is proposed

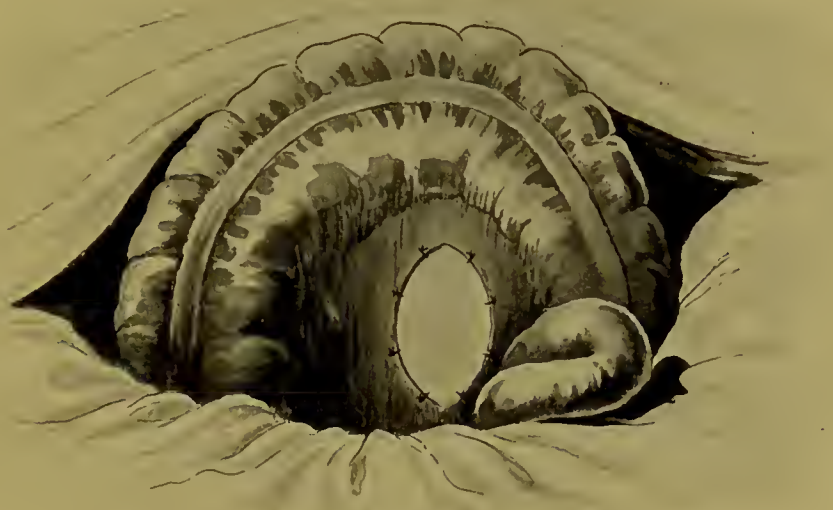


FIG. 64.—POSTERIOR GASTRO-ENTEROSTOMY. *Exposure of the posterior wall of the stomach.* The slit in the transverse meso-colon has been converted into an ellipse and its edges fastened to the posterior gastric wall by sutures. This is the spot chosen for the anastomosis. The exposed stomach wall has been made very light in colour for the sake of contrast.

to make the anastomosis (*i.e.*, close to the greater curvature near the cardiac end) by tearing it parallel with the direction of the vessels and pulling the edges of the rent asunder so as to expose the stomach freely. In order to prevent the edges of the opening in the meso-colon from coming together again they are attached by a few catgut stitches to the posterior gastric wall, leaving exposed the whole area of the latter that is required for the anastomosis (see Fig. 64). This is an important step in the operation; if it be neglected, the opening in the meso-colon is likely to constrict the intestine, and the operation fails.

The jejunum, which has been given to an assistant to hold, is now taken, and the site for anastomosis is selected. It is unnecessary to have any great length of bowel intervening between the point where the jejunum leaves the left side of the spine and the anastomotic opening. The bowel should be simply curved gradually round from the spine from left to right, and the part that lies most comfortably in apposition with the stomach should be

selected. The *jejunum is clamped* so as to prevent the escape of its contents during the later stages, and in this form of the operation the clamping must be done with special care. A Lane's or Makins' clamp (see Figs. 60 and 65) is put upon the bowel on each side of the proposed incision, and at least two inches away from either end of it. The upper clamp should be applied first; this will be put on near the junction of the jejunum with the duodenum, and the intestines should be turned well over to the right to facilitate it. The intestine below should then be emptied by compressing it between the finger and thumb and running them down it beyond the point at which the lower clamp is to be applied. As a rule, the actual opening in the



FIG. 65.—MAKINS' INTESTINAL CLAMP. The blades are sheathed with india-rubber tubing and the amount of separation between them is regulated by the screw.

jejunum will be from six to twelve inches from its junction with the duodenum. In the posterior form of the operation it is impossible to clamp the stomach, and it is, therefore, especially necessary that the organ should be washed out before the operation. An assistant is specially told off to prevent the escape of the contents as far as possible by compressing the lips of the opening when it is made and to remove any contents as fast as they escape.

Before proceeding to attach the jejunum to the stomach, *the field of operation is carefully packed off by aseptic abdominal cloths* (see p. 177); this must be done with scrupulous care as the operation takes place within the abdomen in a somewhat dependent position and all parts of the peri-

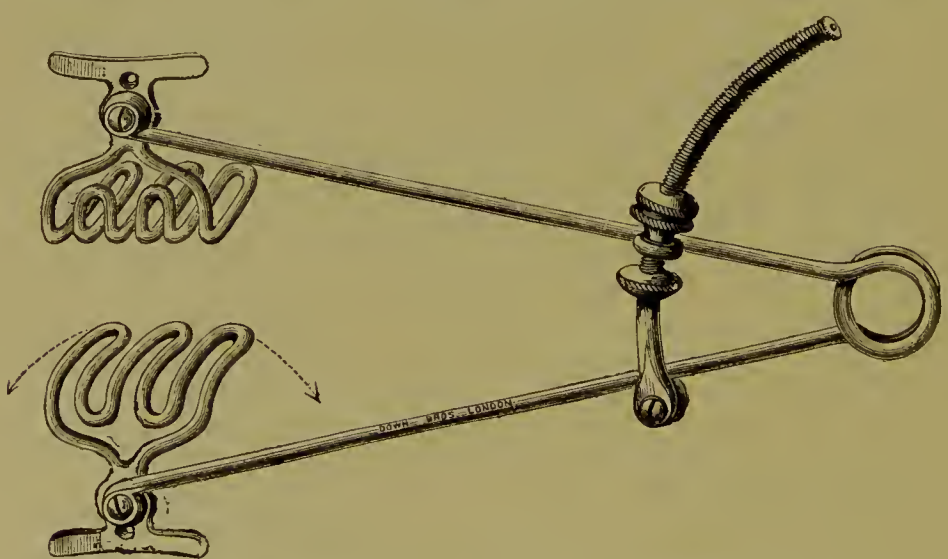


FIG. 66.—MAUNSELL'S ABDOMINAL RETRACTOR. This is a self-retaining spring retractor.

toneal cavity into which any escaped gastric contents could find their way must be carefully guarded by aseptic cloths of suitable size; it will probably be necessary to use several of the smaller abdominal cloths, which can be

packed down into the various recesses, and special care must be taken that they are all counted; the small ones should be provided with a long silk thread the end of which is grasped in forceps so as to render identification and removal easy. In order to facilitate the later steps of the operation and to minimise the amount of assistance required, various aids may be employed in retracting the abdominal wound and in keeping the intestines out of the way. For the former purpose Maunsell's spring-retractor (see Fig. 66) is helpful, while the same surgeon's ingenious intestine retractor (see Fig. 67) is often very useful in securing a clear field for operation.

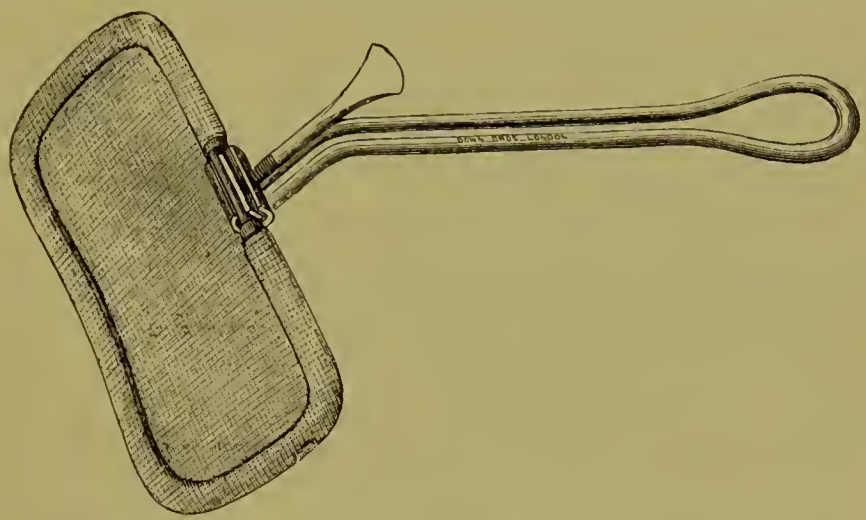


FIG. 67.—MAUNSELL'S INTESTINE RETRACTOR. The frame is covered with gauze and is fitted with a handle that can be fixed at any angle.

The intestine is now attached to the stomach.—In the first place the bowel is laid against the stomach wall over the proposed seat of anastomosis and the proposed incision is marked out with a knife on each organ; only the serous and part of the muscular coats are divided. This insures an incision of identical length and in the proper direction both in the stomach and the jejunum and also greatly facilitates the insertion of the sutures. The opening should be along the convex border of the jejunum parallel to its long axis, while on the stomach it should be slightly oblique from above downwards and from left to right,[1] lying nearer the greater curvature than the lesser and well away from any visible large vessels. A point of the highest practical importance in marking out this incision is to remember that if the stomach be dilated the incision must be quite one-third longer than it would otherwise be, so as to allow for the organ subsequently resuming its normal size, an occurrence that entails a corresponding diminution in the opening into it. The first suture inserted is a sero-muscular continuous stitch of fine silk threaded on a large fully-curved needle at each end and introduced in the following manner. The jejunum and the stomach are

[1] It must be remembered that the stomach is here turned up upon the ribs and its posterior surface is exposed. With the organ in this position, therefore, the incision would be either horizontal or slightly oblique downwards from the patient's right to left.

held in apposition by an assistant and the surgeon passes the suture through the serous and muscular coats of both about a quarter of an inch beyond and below one end of the proposed incision. The stitch is carried through the serous and muscular coats only and is drawn to about the centre of its length and then tied. One needle is given to an assistant to hold whilst the surgeon proceeds with the other to connect the opposed surfaces of the jejunum and the stomach below the proposed incision by a continuous running stitch (see Fig. 68). This suture extends to about half an inch beyond the opposite end of the proposed incision, when it is knotted and



FIG. 68.—POSTERIOR GASTRO-ENTEROSTOMY. *Attaching the jejunum to the stomach.* The line of incision has been marked out on the serous coats of the stomach and the jejunum, and the two portions of the alimentary canal are now attached by the sero-muscular running suture shown in the figure. When it has reached the points shown above, the ends are given to an assistant to hold, and the surgeon proceeds to complete the opening. This suture corresponds to that marked *ab* in the following figure.

the end of the suture given to the assistant. This secures the serous surfaces together throughout the whole of the posterior portion of the anastomosis. Either the continuous running suture above described may be employed, or, if preferred, the ordinary button-hole stitch (see Part I., p. 158); if the former, which is much the easier, be used care must be taken to avoid puckering up the surfaces; if the latter, the serous surfaces must be well approximated each time the needle is passed through. The two ends of this suture are now held by the assistant and the surgeon completes the incision for the anastomosis. The best plan is to open the jejunum first, as there is less likelihood of its contents escaping, whereas it is advisable to open the stomach at the last minute so as to avoid the possibility of the escape of contents whilst the jejunum is being incised. The opening is made with a sharp knife, completing the division of the muscular coat and going through the mucous membrane; it runs the whole length of the preliminary incision through the serous coat (see Fig. 69, *A*). Anything that escapes

from the opening is carefully wiped up on mops that are not used again during the operation. A suture of stout catgut or silk threaded similarly to the first is now taken and made to unite the adjacent lips of the openings in the stomach and the jejunum, which may if necessary be temporarily approximated by catch forceps. This suture should commence at one end of the incision, and, going through all the coats on both sides, firmly unites them and by its pressure stops any bleeding. It should be the ordinary running stitch and is carried completely around the aperture and the two ends of the suture are then knotted together, taking care not to purse up the orifice (see Fig. 69, *B* and *C*)

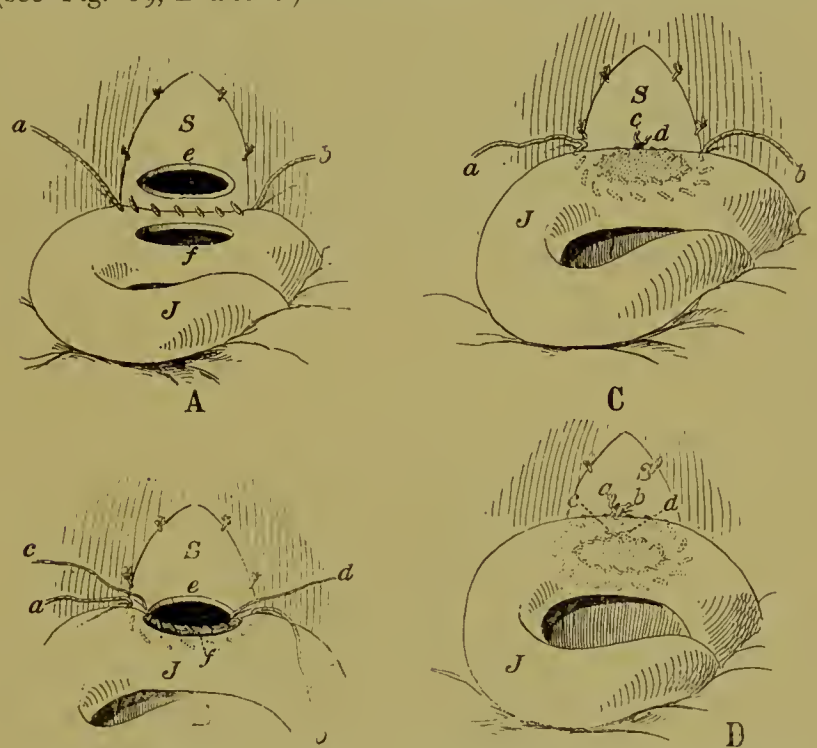


FIG. 69.—POSTERIOR GASTRO-ENTEROSTOMY. *Making the anastomotic opening.* In *A* the opening into the stomach and that into the jejunum have been made. In *B* the adjacent lips of these two openings have been united by a suture taking up all the coats, and carried round half the circumference of the opening. In *C* this suture has been completed by carrying it entirely around the opening and tying its ends together. Finally, in *D* the operation has been completed by carrying the original sero-muscular suture first introduced (see Fig. 68) round outside the inner suture and tying its two ends. *S*=stomach (post. wall). *J*=jejunum. *ab*=outer sero-muscular suture. *cd*=inner continuous suture uniting the adjacent edges of the openings in the stomach and jejunum and taking up all three coats of each.

The line of union is now carefully mopped up with sterilised swabs so as to remove any traces of extravasated gastric contents, and all that remains is to finish off the original suture, the ends of which have been left long and entrusted to the assistant. This when completed takes up the adjacent sero-muscular surfaces about a quarter of an inch external to the continuous suture just inserted. The surgeon will generally proceed by using the end of the suture which was left long in the first instance and, when this reaches the one inserted along the posterior surface, the ends of the two are tied together and cut short (see Fig. 69, *D*). The continuous suture uniting all the coats is thus buried front and back and, by commencing the sero-

muscular suture in this manner, first of all along the posterior aspect of the anastomosis, there is no difficulty whatever in securing approximation all the way around the opening.

The final steps in the operation consist in swabbing up carefully the area of operation with mops dripping with normal saline solution, removing the abdominal packing and the intestinal clamps and dropping the stomach back into the abdominal cavity. When removing the packing, special attention should be paid to the cleansing of the peritoneal surface in the neighbourhood of the posterior line of union because it is here that soiling is most likely to occur.

When the stomach is finally dropped back into position, the anastomosis should be carefully examined to see whether there is any tendency to kinking of the efferent portion of the intestine, and it is a good plan in all cases to take the precaution to insert one or two stitches between the efferent loop of the jejunum and the stomach wall so as to make that portion of the bowel leave the opening in a gradual incline and thus to prevent any risk of kinking and the establishment of a vicious circle. On the proximal side of the opening stitches are unnecessary as the intestine comes straight from the pancreas and is not likely to become kinked. The abdominal wall is closed in the usual way (see p. 190). If the patient be at all collapsed it is well to fill up the abdominal cavity with as much hot normal saline solution (105° F.) as it will hold.

Anterior gastro-enterostomy.—This form of the operation is divided into two varieties called the pre-colic and retro-colic forms, but for reasons already given (see p. 241) we do not advise the latter and shall only describe the former.

After the jejunum has been identified and its direction made out, the stomach with the transverse colon and the omentum are replaced in position in the abdomen and a portion of the jejunum is found that will easily rest on the anterior surface of the stomach without any tension and without constricting the transverse colon, across which of course it must pass. Should the portion first taken prove too short, a loop further down should be chosen. It is absolutely essential for the success of the operation that there should be no possibility of the intestine cramping the movements of the transverse colon. The anastomosis is usually satisfactory if a point about two feet from the commencement of the jejunum be selected. The distance should not in any case be much greater than this as otherwise an unduly heavy intestinal loop will exist between the duodenum and the opening and this, when filled with bile and pancreatic secretion, might pull unduly and cause a vicious circle. When choosing the loop, care must also be taken to see that the peristaltic current is in the proper direction, namely from left to right. The jejunum is now clamped on either side of the proposed artificial opening, as already described, and the abdominal cloths are carefully arranged so as to shut off the area of operation from the rest of the peritoneal cavity. Practically speaking the operation can

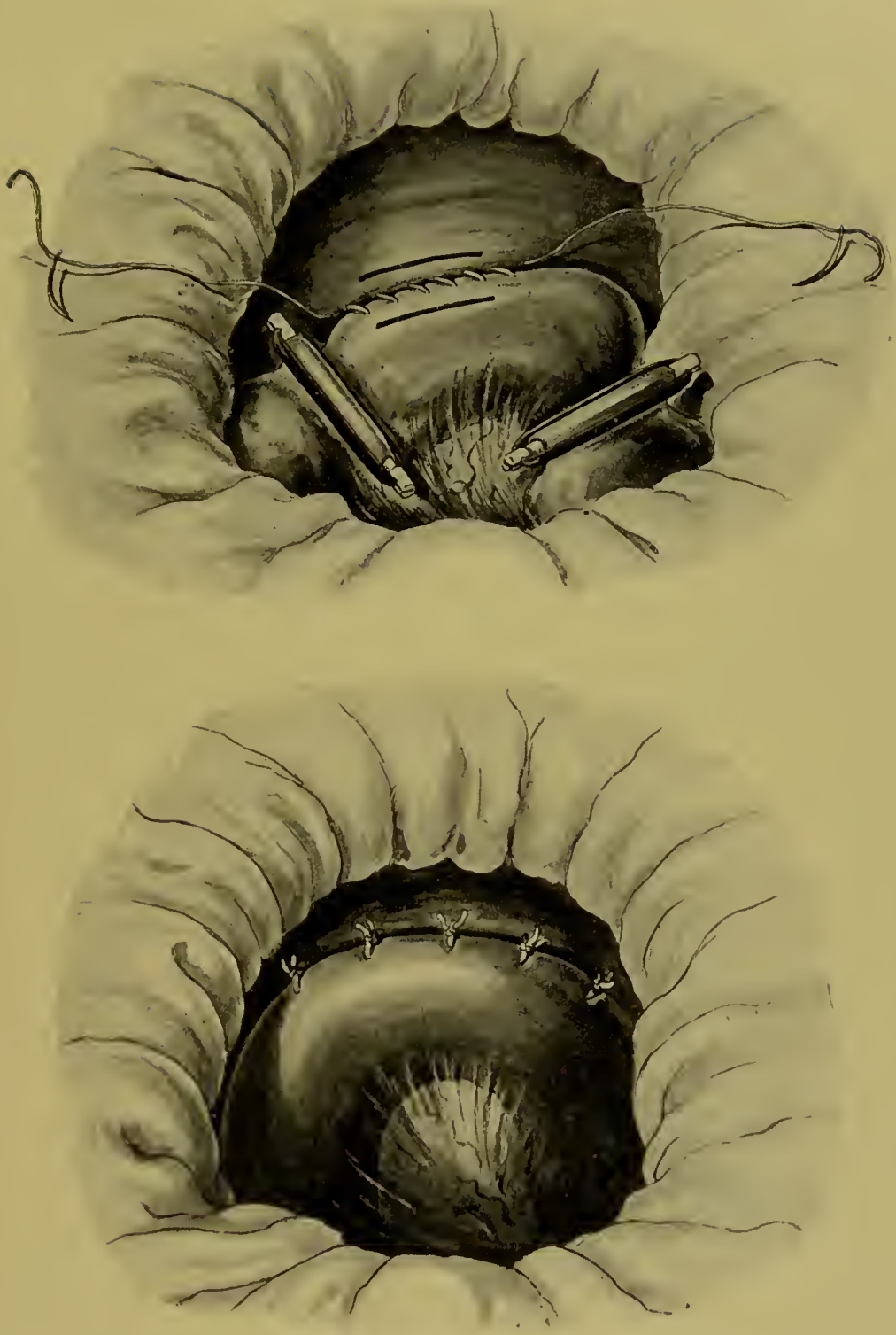


FIG. 70.—ANTERIOR GASTRO-ENTEROSTOMY. The upper figure shows the jejunum attached to the anterior surface of the stomach by the lower half of the continuous sero-muscular suture. The proposed incisions into the stomach and the jejunum have been marked with the knife on the peritoneal surfaces.

The lower figure is designed to show how the "anti-kinking" sutures are inserted after the operation is completed and the clamps removed. Four or five interrupted sero-muscular stitches are inserted after the jejunum has been arranged so as to lie in a bold curve on the stomach wall.

be done entirely outside the abdomen by pulling the stomach well out into the wound and packing abdominal cloths all around. The proposed opening is now marked out on the adjacent surfaces of the stomach and intestine, as in the former case; that on the stomach should be situated nearer the greater than the lesser curvature, as near to the pyloric end as convenient and should be inclined obliquely from above downwards and from left to right. A sufficiently long jejunal loop should be taken to allow the intestine to slope gently down from left to right without any kinking towards the left hand end (see Fig. 70).

The next step of the operation, namely, the insertion of the sero-muscular suture below the margin of the anastomotic opening, is performed in exactly the same manner as for the posterior operation (see p. 249). When this is in place, the surgeon proceeds to open the jejunum first and then the stomach; in the latter organ very effectual compression may here be made by the fingers of an assistant applied all round the opening. The steps of the actual anastomosis are identical with those in the posterior operation (see p. 250), and when done, the clamps and packing are removed and the parts put back into position; finally, a most careful examination must be made of the anastomosis to see that no kinking is likely to occur. This is a point of the very highest practical importance and no consideration of time should ever be allowed to override it. It is a good plan to insert two or three interrupted sero-muscular sutures between the adjacent surfaces on both sides of the anastomotic opening and, previous to doing this, to arrange the jejunum on the stomach so that kinking cannot take place and that the intestine forms a gentle curve both to and from the anastomosis. Should the surgeon find that kinking does occur and that it is impossible to rectify it by suturing in this manner, he must, sooner than leave the condition alone, adopt one of two alternatives. He must either divide the small intestine on the proximal side of the anastomosis, invaginate the end next the opening in the stomach and implant the other end laterally into the intestine below the anastomosis—*i.e.*, he must employ the Y-method of gastro-enterostomy, which is fully described later (see p. 256)—or he must do a lateral anastomosis between the afferent and the efferent loops well below the opening into the stomach. Both these operations will be dealt with in connection with the vicious circle and its treatment. The first method will probably be chosen if time allows; the second, which can be done by Murphy's button, if speed be of great consequence.

Modifications of the operation.—Various modifications have been introduced to avoid the various inconveniences to which the operation is liable. Thus, in order to avoid pressure of the intestine upon the colon and *vice versâ*, in the anterior operation, it has been advised that a coil of the ileum should be employed for anastomosis instead of the jejunum. This is however not only unnecessary but actually harmful in that it cuts off a very important portion of the intestine from the intestinal circuit and moreover a point about two feet from the commencement of the jejunum usually

satisfies the demands of any case. Another plan to obviate the same trouble is to split the omentum vertically and to carry the loop through this to the anterior wall of the stomach. This has been suggested chiefly lest the omentum should become the seat of an extensive deposit of fat and thus press injuriously on the intestine, but the procedure possesses no particular advantage. The other method, namely, the retro-colic form of the anterior operation, has already been referred to (see p. 241). Of course if the posterior operation be performed these troubles will be avoided, but if the anterior form be done as above described it will probably meet the requirements of the great majority of cases.

The vicious circle and its prevention. — *Kocher's operation.* — The avoidance of kinking with its consequent vicious circle which has already

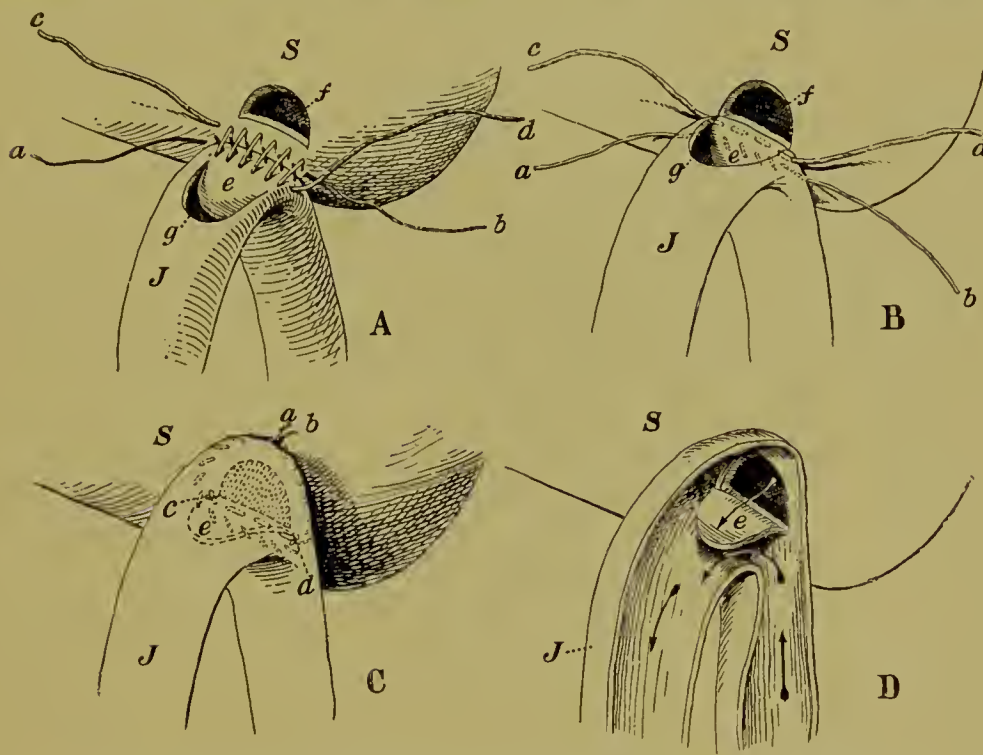


FIG. 71.—KOCHER'S GASTRO-ENTEROSTOMY (diagrammatic). In *A* the jejunum (*J*) has a crescentic incision made into it, and is attached to the stomach (*S*) by the continuous suture *ab*. The incision into the jejunum makes a flap (*e*), the base of which is sutured in *B* to the stomach below the opening (*f*) by the continuous suture *cd*. Both sutures are sero-muscular only. In *C* the operation has been completed by carrying the continuous suture *ab* all round the opening. *D* shows a diagrammatic section indicating the theoretical action of the valve-like flap of jejunum (*e*) with regard to the currents coming from the stomach on the one hand, and the duodenum on the other.

been referred to (see p. 243), is very important and various plans have been suggested to this end. Some, such as Kocher, make a linear incision into the stomach and a curved one into the intestine so as to form a flap like the end of the thumb which has its base towards the left. The idea is that the flap hangs down into the lumen of the intestine and acts as a sort of valve guiding materials from the stomach into the efferent loop. The probability is that this flap does not act so well as it is supposed theoretically to do. It retracts in the first instance when it is cut and must shrink still further

during healing, so that ultimately there is probably very little valvular action. The operation no doubt gives a free opening from the stomach into the intestine and it is possible that the shrunken flap may help as a sort of spur in the early stages to prevent the contents of the duodenal loop finding their way into the stomach, but it is hardly to be expected that it can act as a valve that hangs down and controls the passage of the intestinal contents. A glance at Fig. 71 will show how the operation is done.

The Y-*operation.*—Another plan for avoiding the formation of a vicious circle which is especially applicable when it is impossible to fix the intestine to the stomach without kinking,—as will be the case when only a small portion of healthy stomach wall is available for anastomosis,—is the operation that goes by the name of the Y-operation. In it the afferent loop is divided transversely just before the gastro-enterostomy opening is reached; the distal side of this division is then invaginated and permanently closed, whilst the proximal side is implanted into the efferent loop laterally some inches below the seat of the gastro-enterostomy. Here the contents (bile and pancreatic secretion) of the afferent or duodenal loop enter the small intestine well below the orifice in the stomach, whilst the gastric contents have no option but to travel in the right direction along the efferent loop. Theoretically this is a most satisfactory operation; practically it is somewhat complicated and is apt to take a good deal of time and thus to be too severe unless the patient's condition be good.

The simplest plan of performing the operation is to proceed as for gastro-enterostomy up to the point at which the jejunum is identified. This structure is examined and a careful selection is made of the spot at which its division is to be effected. This will vary according to whether the anastomosis is to be on the anterior or the posterior surface of the stomach; as a rule it is done in the former case as there is not so much risk of the formation of a vicious circle if the ordinary posterior form of gastro-enterostomy be performed. The jejunum is now clamped, the upper clamp being placed about three inches above the site of division, the lower, an inch below it, the contents of the intestine being squeezed out between. The jejunum is now cut cleanly across transversely to its long axis or preferably slightly obliquely from above downwards from its convex to its mesenteric border, and the mesentery is also torn in a continuation of this incision backwards for two or three inches. The open end of the duodenal loop is now covered up in a sterilised cloth and given to an assistant who holds it out of the way during the next stages of the operation, which consist in implanting the open end of the efferent or jejunal loop into an incision on the anterior wall of the stomach made similarly to that for the ordinary anterior gastro-enterostomy. The sutures are inserted in the same way beginning with the lower half of the outer sero-muscular suture of fine silk, continuing with the inner stout suture of catgut or silk uniting all the coats of the stomach and jejunum completely around the orifice, and terminating with the completion of the original sero-muscular suture.

Finally the open end of the afferent or duodenal loop is uncovered and is implanted by lateral anastomosis into the convex border of the efferent or jejunal loop about two or three inches below the gastro-enterostomy opening (see Fig. 72). Before this anastomosis is done it is important to insert another clamp upon the efferent loop immediately below the entero-enterostomy orifice to prevent the intestinal contents escaping through the lateral incision in the intestine. The lateral implantation is done in the same way as the gastro-enterostomy. All that now remains to do is to remove the clamps and to put one or two catgut stitches into the tear in the mesentery.



FIG. 72.—THE Y-OPERATION IN ANTERIOR GASTRO-ENTEROSTOMY. If this be compared with Fig. 70 it will be seen that the loop of jejunum there shown has been cut across between the clamps, another clamp applied below the distal one, and the open distal end of the jejunum implanted into the anterior surface of the stomach while the proximal end is implanted laterally into the jejunum below the gastro-enterostomy opening. The operation shown above is done by simple suture.

Another way of doing the same operation is to proceed to perform an anterior gastro-enterostomy in the ordinary manner first of all (see p. 252) and then to divide the jejunum on the proximal side of the anastomosis and to implant the open duodenal end laterally into the small intestine well below the gastro-enterostomy, invaginating and permanently closing the other end. On the whole the first method is probably the better as there is some risk of disturbing the gastro-enterostomy sutures when dividing and invaginating the open end of the bowel, through which, moreover, it is difficult to prevent the escape of gastric contents.

This operation is undoubtedly absolutely preventive of the extremely grave condition of "vicious circle," but its severity is such that it is not

advisable to perform it in all cases. We should give the following as the indications for its use. When there is extensive perigastritis with many adhesions and much deformity of the stomach the surgeon may be unable to apply the intestine so as to be sure that subsequent kinking cannot occur, and it has even happened to us that in a case of this kind secondary kinking has resulted, in spite of the most careful suturing at the time of the operation, from the distortion of the small intestine by the contraction of the perigastric adhesions; this is a point of considerable practical importance. A similar remark applies in extensive cancer of the pylorus where the anastomosis has to be made at the extreme left end of the stomach and where therefore kinking is almost certain to occur. The operation may also be necessary in hour-glass contraction of the stomach where the constriction is so near the cardiac end as to leave only a small surface for anastomosis.

The Y-operation should not be done however in any of these cases if the patient be very feeble, as it practically doubles the severity of



FIG. 73.—ENTERO-ENTEROSTOMY FOR THE CURE OF THE "VICIOUS CIRCLE." A fresh anastomotic opening is made between the afferent and efferent loops through which the contents (*bb'*) of the duodenum can pass direct into the efferent loop without passing through the gastro-enterostomy opening (*a*) into the stomach. Also, if the stomach current (*a*) passes into the duodenal loop it will escape into the efferent portion of the bowel in the direction of the arrows *b*, *b'*.

the operation, and would be likely to prove fatal from shock. However something of the kind is absolutely called for in all the cases that we have mentioned, and in practically all of them the posterior gastro-enterostomy is not feasible. Under these circumstances we should be inclined to recommend that, in addition to the gastro-enterostomy, an entero-enterostomy

or lateral anastomosis between the afferent and efferent loops below the stomach opening should be employed in preference to the Y-operation (see Fig. 73). The reason for this is that such an operation is very rapidly done and can be effected if necessary with a Murphy's button or a Mayo Robson's bobbin.

Artificial aids to anastomosis.—For efficiency nothing compares with simple suture in gastro-enterostomy. At the same time it must be admitted that, even in the most skilful hands, it takes a fairly considerable time, and of recent years many most ingenious artificial aids have been introduced to facilitate the anastomosis and thus to shorten the length of time taken by the operation and consequently the shock to which the patient is exposed. Some surgeons on the other hand go in the opposite direction, and are at the pains to make the anastomosis with a triple row of sutures; this however unduly prolongs the operation and is quite unnecessary. Other surgeons again use interrupted sutures, such as the ordinary Lembert's or Halsted's (see p. 213), but these not only require considerable skill in their application, but any one misplaced stitch may vitiate the whole operation; they are therefore being largely supplanted by the continuous form. Another method, to which we shall do no more than refer, is that known as Maunsell's method, which finds a place in all text-books upon this subject. We are strongly of opinion that not only does it possess no advantage over the operations that we have described in any respect, but that it is actually more difficult, particularly for a beginner.

On the other hand, considerable value attaches to various mechanical aids in the performance of this operation. These are valuable in two ways; they shorten the operation under any circumstances and therefore diminish shock,—a point of importance in some cases,—and they have in addition the great value that they place the operation within reach of those who are not specially skilled in intestinal suture. They are all based on the same principle, namely, they afford a mechanical support around which the bowel is united, this support remaining in position for a period varying according to the nature of the appliance. While preferring simple suture in all cases where time is not an absolute essential, we are of opinion that some of these methods have a great value, and the best of them, namely, Mayo Robson's bone bobbins and Murphy's button, we shall describe in detail as every surgeon should at least possess these amongst his instruments. Senn's bone plates, which were the pioneers of these artificial aids, although of great service at one time, have had their day, and are entirely replaced by the more modern methods.

Mayo Robson's bobbins.—These are hollow cylinders of decalcified bone, shaped as shown in Fig. 74, and of different sizes for use in different situations. They have the great advantage that they enable the operation to be performed rapidly, and the suture is likely to be more safe in the hands of a beginner when performed with their aid than when simple suture alone is employed. The points aimed at in the bobbin are to

secure a mechanical support upon which to perform the suture as rapidly as possible, to make this support of such a nature that it has a large lumen in proportion to the size of the bobbin and therefore permits the passage of the intestinal contents through it from the time of the anastomosis, and lastly, and perhaps most important of all, to make it of a material that disappears after a very short time, so that it is impossible for it

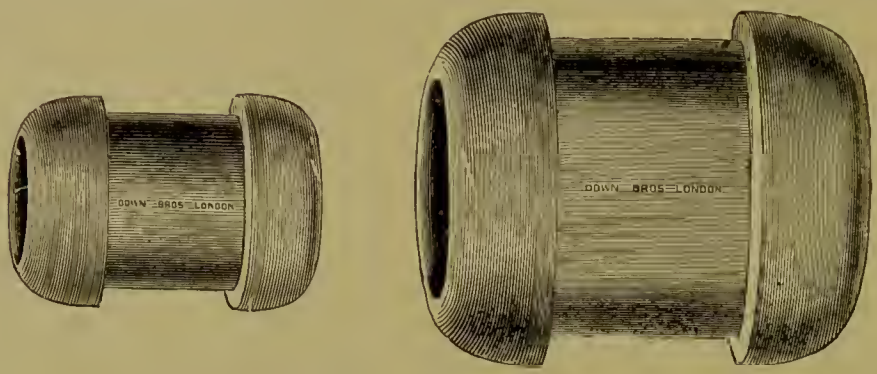


FIG. 74.—MAYO ROBSON'S DECALCIFIED BONE BOBBINS. The larger size is suitable for the colon, the smaller for the small intestine. The drawings are full size.

to remain as a foreign body in the intestinal canal. The largest sized bobbin that the intestine will admit should always be used in all cases, and in gastro-enterostomy it is introduced as follows:

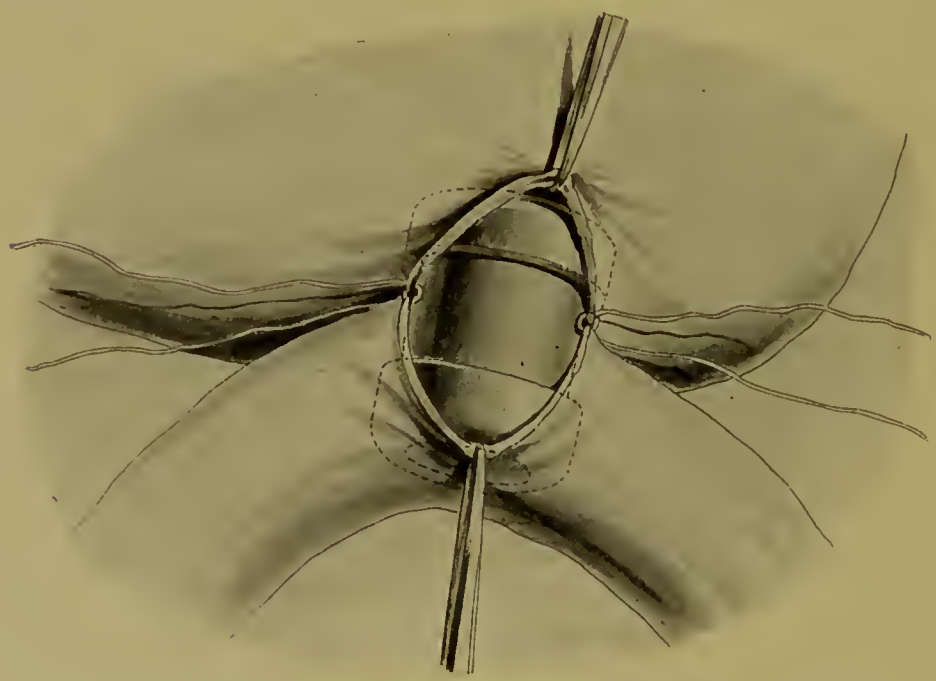


FIG. 75.—GASTRO-ENTEROSTOMY BY MAYO ROBSON'S BOBBIN. *Inserting the bobbin.* The lower of the two sutures is the sero-muscular one, the upper one is the catgut stitch uniting the lips of the incision in the stomach to that in the jejunum. Both have been carried half way round and at this stage the bobbin is introduced.

After the proposed incision has been marked out upon the adjacent stomach and jejunal walls and previous to opening either of them, a sero-muscular suture of medium silk, about eighteen inches long and

threaded with a fully-curved needle at each end, is inserted about a quarter of an inch below the proposed opening in exactly the same way as is the first or outer stitch in gastro-enterostomy by simple suture (see Fig. 68); the two ends of this are given to an assistant to hold. The stomach and jejunum are opened and a second catgut suture taking up the entire thicknesses of the adjacent posterior or lower lips of the incisions in the stomach and jejunum is introduced exactly as for simple suture (see Fig. 69, *B*). When the entire lower lip of the incision is thus united, the two ends of this suture are also given to the assistant to hold whilst the surgeon takes a bobbin of suitable size and introduces one end into the opening in the stomach and the other into that in the



FIG. 76.—GASTRO-ENTEROSTOMY BY MAYO ROBSON'S BOBBIN. *Completing the anastomosis.* The figure shows well how the bobbin is held in place while the stitch uniting the cut edges of the stomach and jejunum is completed. When this is done, the outer sero-muscular suture, the ends of which are seen in the figure, is completed.

jejunum, keeping the bobbin in position by placing the thumb and forefinger of the left hand over it through the intestinal coats (see Figs. 75, 76). With the other hand[1] one end of the inner stout catgut suture is taken and the approximation of the divided visceral walls is completed, taking up all the coats of the adjacent edges as before. The two ends of this suture are then drawn together around the bobbin, so that the line of union lies in the shallow groove in the centre, and it is tied as firmly as possible; this of course effectually shuts off the intestinal canal and at the same time fixes the bobbin so that it cannot slip. All

[1] Should the surgeon require both hands free for introducing the suture, the bobbin is kept in place during the completion of the deeper suture by the thumb and forefinger of an assistant.

that now remains to be done is to complete the original outer or sero-muscular suture, the two ends of which are tied together moderately tightly and cut short. The clamps are then removed and the operation is complete. It is usual to put in a double suture in this manner, but, should the case demand great speed, it is claimed that the operation may be performed by a single suture taking up the serous and muscular coats throughout.

It is evident that this method of suture is almost the same as that employed for simple suture without artificial aid, and that nearly the same length of time must be consumed in it. The primary object of the bobbin, therefore, is to give a mechanical support and to enable the opening to be closed with great accuracy and without pursing up the suture. It is therefore especially valuable in the hands of those who, from want of experience, are not confident of their power to approximate the intestinal surfaces throughout by simple suture so accurately that there shall be no leakage. It has the disadvantage over Murphy's button (*vide infra*), in that it takes somewhat longer to introduce, but it has the enormous advantage over it in that it possesses a large lumen so that there is no obstruction to the passage of intestinal contents, and in that, being made of decalcified bone, it rapidly disappears and cannot block the intestinal canal. As a matter of fact, the bobbin when in contact with water softens with great rapidity, so that it is advisable not to remove it from the absolute alcohol in which it is sent out from the makers until a few minutes before it is inserted into the intestine, when it is just washed through a watery solution and inserted; if allowed to soak in water or carbolic solution during the earlier stages of the operation it will be too soft to be of any use. It never reappears, as it first softens and then becomes digested; it entirely disappears in a very short time, and, in our own practice, we have seen the semi-digested bobbin vomited within nine hours of the operation so much altered that it was only just recognisable. It, therefore, cannot possibly do harm from its presence in the intestine.

Murphy's button.—This ingenious contrivance enables the surgeon to effect the anastomosis in a minimum period and with a minimum of suture, whilst at the same time it insures an absolutely perfect approximation when properly applied. The button (see Fig. 77) consists of two halves, which are termed male and female, with a hollow central stem through which the circulation of the intestinal contents is able to take place. The two halves are so made that, whereas they can be rapidly pressed together, they cannot be separated afterwards except by a process of unscrewing. This enables the button to be introduced very rapidly and insures that the two halves shall not come apart when it is in position. In order to avoid undue pressure upon the portions of bowel nipped between the flanges of the button, as would happen were this pressed home unduly forcibly, and also to prevent the possibility of leakage as the compressed portions undergo thinning and slough, the male portion is provided with an inner flange which is actuated by a spring so arranged that a constant pressure

is always maintained. The buttons are of various sizes to fit the various portions of the intestinal tract, to any or all of which they are applicable. When properly applied, the pressure of the button aided by the spring flange causes a localised atrophy or gangrene of the portions nipped between the two halves and this is accompanied by an adhesive peritonitis which glues together the serous coats of the approximated ends. When the gangrenous portion separates, the button becomes loose in the intestinal canal and the two approximated ends are firmly united by adhesive peritonitis, while at the same time the openings into the two portions of the intestinal canal are of the same size. If the button be properly applied, no leakage can possibly occur in the first instance because it is quite easy to insure mechanically perfect approximation and, until the button has become loosened by the necrotic processes, no escape of intestinal contents can possibly occur. The button is employed as follows:

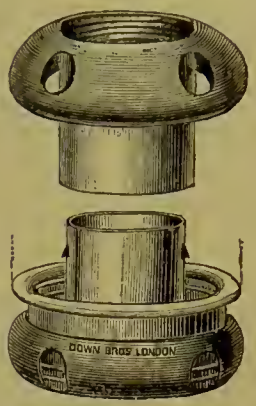


FIG. 77. — MURPHY'S BUTTON FOR INTESTINAL ANASTOMOSIS. The button shown above is the full size that would be used for gastro-enterostomy.

The early stages of the operation are similar to those of simple suture.



FIG. 78.—GASTRO-ENTEROSTOMY BY MURPHY'S BUTTON. *Insertion of the purse-string sutures.* The jejunum is applied to the anterior wall of the stomach and the intended incisions are marked out on the peritoneal coats. The suture in the jejunum is completed and in the stomach nearly so.

When the opening has been marked out on the stomach and jejunum a large

fully-curved needle threaded with medium-sized silk is introduced as shown in the diagram (see Fig. 78), being carried through all the coats of the stomach so as to take them up in a running purse-string suture, about a sixth of an inch all round outside the proposed line of incision, which should always be marked out in the first place and should not exceed in length two-thirds of the diameter of the button. A similar suture should be introduced through the wall of the jejunum, and the two ends of each are left long and clamped in forceps.

The incision in the stomach should now be completed by carrying it through the mucous membrane. The female portion of the button is



FIG. 79.—GASTRO-ENTEROSTOMY BY MURPHY'S BUTTON. *Insertion of the halves of the button.* The male half of the button is being introduced into the jejunum. The figure shows how the button is grasped and tilted so as to insinuate it into the relatively small incision. The other half has already been introduced into the stomach, and the purse-string suture drawn tight and tied around its stem. The button is held up out of the way by an assistant who holds the forceps grasping the button.

grasped in forceps as shown in Fig. 79, and is readily introduced with a little manipulation through the opening into the stomach; when the button is in position the opening should be only slightly longer than the diameter of the central stem of the button, which is then pulled well up so that the flange of the button lies in contact with the mucous membrane, whilst the central shaft just projects through the opening (see Fig. 79). The forceps are then given to an assistant to hold and the purse-string suture is tightened, any mucous membrane projecting beyond the level of the

divided serous and muscular coats being clipped away with a pair of fine scissors. Finally the purse-string suture is tied as tightly as possible around the stem of the button; if the suture be carried through all the coats of the stomach as described above there is no risk of its cutting through. A piece of gauze or a small abdominal cloth is then thrown over the end of the button in case any of the gastric contents escape, and the assistant holds it well up out of the way with the forceps attached to it whilst the surgeon introduces the male portion of the button into the small intestine in an exactly similar manner. When the two halves of the button are in position the surgeon grasps the male portion in one hand and the female in the other (see Fig. 80); the assistant takes off the forceps, and the two



FIG 80.—GASTRO-ENTEROSTOMY BY MURPHY'S BUTTON. *Approximation of the two halves.* The figure shows how the two portions should be held when they are pressed together. There is rather a redundancy of tissue around the stem of the lower half; this is easily pared down with scissors if necessary.

halves of the button are approximated by pressing upon their ends through the intestinal walls. It is sufficient to press the button firmly home without employing any great force. The clamps are then taken off, the seat of operation is cleansed in the ordinary way and the operation is complete. Some surgeons introduce a circle of Lembert's sutures outside the button, but this is not at all essential and, as Murphy's button is as a rule only used for cases of urgency, the time thus spent is a matter of importance.

There has been much discussion as to the merits of the button in recent years and, in order to get the best results from it, the following *precautions* must be carefully attended to. In the first place no portion of the mucous

membrane must protrude between the adjacent peritoneal surfaces when the approximation is complete. This is a fatal mistake, and has undoubtedly occurred as a result of undue haste or careless insertion of the purse-string suture. The best way to avoid it is to introduce the latter as near to the line of incision as is safe and, when the suture is tightened around the central shaft of the button, to see whether mucous membrane projects above the line of division of the other coats, and if it does to clip it away with fine scissors.

A second point is that the button should not be closed too tightly. A moderate amount of pressure is quite sufficient to make a perfectly safe anastomosis as in the early stages, before the adhesive peritonitis has occurred, the intestinal canal is mechanically shut off by the firmly tied purse-string suture. The occurrence of adhesive peritonitis is insured by the spring pressure of the movable flange which maintains constant approximation.

A third point and one of very great importance is that a button of proper size should always be chosen. If used for gastro-enterostomy, the size of the button is of course a matter of no importance as far as the stomach is concerned; on the side of the jejunum however the question is quite different. If the intestine be stretched tightly over the half of the button in it, ulceration is very apt to occur over the holes in the flange of the button and fatal perforation may result. Moreover the stretching of the bowel wall over the end of the button must necessarily occlude its lumen, and the passage of the intestinal contents must be prevented. This point is more important in cases of lateral anastomosis such as gastro-enterostomy of which we are now speaking, than in the end-to-end form, but in both it is a matter of very great consequence.

In introducing the button the surgeon must always remember that when it is once in position there is no means of getting it out short of excising the portion of the bowel in which it lies, as it is impossible to unscrew the halves from outside. Hence every precaution must be taken before pressing the two halves together to see that the surfaces of the bowel are in proper relative position. This is most important in end-to-end anastomosis, as otherwise the mesenteric attachment on the two sides may not correspond.

The advantages of the button are its extreme simplicity and the rapidity with which it can be introduced. By attending to the indications given above it can be introduced by anybody with very little risk. *It undoubtedly possesses disadvantages* however, and one of the greatest applies especially to the operation that we are now describing, namely, the short-circuiting operation of gastro-enterostomy. There are three directions in which the button can go when it becomes loose: it may pass onwards into the efferent loop of the intestine and so downwards to the anus, which is the direction desired: it may fall back into the stomach, in which case it may be vomited and thus may be got rid of, or it may remain there as

a foreign body causing a good deal of annoyance and probably gastric ulceration: and finally it may fall back into the afferent or duodenal loop of bowel, where it may remain indefinitely, generally giving rise sooner or later to ulceration and perforation. This is a most serious drawback, and, should it happen, the only safe procedure is to perform an enterotomy and remove the button. For this reason we have suggested that the male half of the button should be placed in the small intestine because the constant action of the spring rather tends to induce the button to fall into the small intestine than to drop back into the stomach. In order to make this more certain we had a button made some years ago in which one flange was larger than the other, so that, by introducing the larger flange into the small intestine, the button is prevented from passing back into the stomach and must as a matter of necessity travel in the desired direction (see Fig. 81). The danger from the button dropping into the short-circuited loop of bowel is not so great in gastro-enterostomy as in similar operations between the large and the small intestines as the loop of duodenum still takes part in the intestinal circulation and would be likely to pass on the button along with the bile and pancreatic juice.

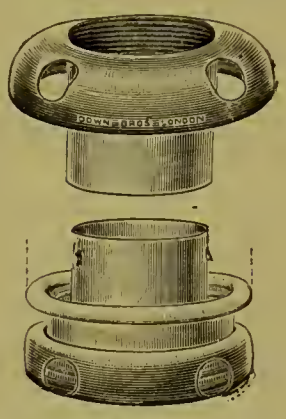


FIG. 81. — MODIFIED INTESTINAL BUTTON FOR USE IN SHORT-CIRCUITING OPERATIONS. The upper half of the button is larger than the lower and is always introduced into the distal portion of the bowel so that the button must fall into that part when it becomes loose.

A disadvantage justly urged against the use of Murphy's button is that the opening it makes is very small relative to the size of the button, and that this opening, made as it frequently is in a hurry, in cases of marked distension from obstruction, becomes smaller as the dilatation of the proximal portion of the intestine subsides, until eventually the opening is so small as to cause a recurrence of the symptoms of obstruction. While this objection is common to all forms of mechanical appliance, it is especially applicable to Murphy's button and more in the cases of which we are now speaking, namely gastro-enterostomy, than in any others. In the operation of gastro-enterostomy it is most important to have a large opening and, since the calibre of the jejunum is comparatively small, only a small-sized button can be used, and therefore the anastomotic opening must be smaller than the surgeon would make for choice. If, in addition, the stomach be much dilated at the time of operation, as it often is, rapid recurrence of symptoms may set in as the dilatation of the stomach subsides and the consequent contraction of an already small opening occurs.

We should only employ the button in cases of extreme urgency, where the condition of the patient is not such as to warrant the operation being performed by simple suture. We are certainly inclined to think that, with a surgeon accustomed to perform simple suture, the difference in the time

taken by the operation is not material; if the patient be kept thoroughly warm and the cloths surrounding the operation area be kept hot by repeated changing, the increase in the risk is not great.

The length of time that the button may be retained in the intestinal canal varies greatly. In some cases several weeks have elapsed before it has appeared in the rectum, and it is probable that its onward passage had then become arrested at the ileo-cæcal valve. Its presence and position in the abdomen can of course always be ascertained by skiagraphy.

After-treatment in gastro-enterostomy.—If the patient be very collapsed after the operation, a large enema of saline solution at the body temperature and containing an ounce or two of brandy should be given per rectum and an injection of strychnine (♏ x.) hypodermically. The feeding should be conducted on precisely the same lines as after an ordinary gastrotomy (see p. 217). There will probably be more pain complained of in these cases and morphine will be called for fairly frequently for the first 48 hours, but it should only be given as sparingly as possible on account of disturbance of the digestive system. After the first 24 hours the thorax should be slightly raised so as to facilitate the passage of the gastric contents through the artificial opening. The remarks made as to aperients after gastrotomy (see p. 217) apply equally here; great care should be taken to prevent flatulent distension which is not only painful to the patient, but is trying to the anastomosis and also encourages nausea and vomiting. The best way to prevent this is by the early administration of enemata and aperients and the use of the flatus-tube frequently. Aromatics, etc., do not do much good. Solid food may be given any time after the first ten days and this should at first be carefully minced so as to leave no large masses which might block the aperture mechanically. By the end of the third week the patient may be allowed to get up and may be considered well.

Treatment of complications arising after the operation.—Of obstruction.—Of these *compression of the transverse colon by the jejunal loop or vice versâ*, and the method of avoiding it, has already been referred to (see p. 242). This condition should certainly not arise, at any rate immediately after the operation; it is possible that at a later date an excessive deposit of fat in the omentum may give rise to it and under those circumstances there will be symptoms of gradual obstruction, either in the small or large intestine as the case may be, necessitating laparotomy, and when the nature of the case is recognised it may be remedied by splitting or removing the omentum between the two portions of intestine.

Another accident that may occur is a form of *volvulus of the afferent loop* due to a twisting upon its mesenteric attachment; this results from leaving an unduly long loop intervening between the duodenum and the anastomotic opening. This loop becomes distended with bile and pancreatic secretion and is thus comparatively very heavy and twists upon itself.

The treatment for this condition is to unwind the twist and then to

perform an *entero-enterostomy* or lateral anastomosis between the afferent and efferent loops well towards the bottom of the former (see Fig. 82).

Of the "vicious circle."—This most important complication has already been fully described (see p. 243). It is an accident that calls for immediate and efficient treatment if the patient's life is to be saved. The onset of the mischief is usually marked by persistent vomiting which comes on some short time after the anæsthetic vomiting is recovered from and is unaccompanied by symptoms of peritonitis.



FIG. 82.—ENTERO-ENTEROSTOMY FOR THE CURE OF THE "VICIOUS CIRCLE." A fresh anastomotic opening is made between the afferent and efferent loops through which the contents (*bb'*) of the duodenum can pass direct into the efferent loop without passing through the gastro-enterostomy opening (*a*) into the stomach. Also, if the stomach current (*a*) passes into the duodenal loop it will escape into the efferent portion of the bowel in the direction of the arrows, *b*, *b'*.

In the earliest stages of the affection the symptoms have been known to subside after simple *washing out of the stomach* commenced early and performed persistently twice daily for a week or more after the operation; at the same time the patient is propped up in bed as much as possible. This probably acts by removing the gastric contents, checking the peristalsis and allowing the stomach and the afferent loop time to contract and thus the intestinal stream is guided in its proper direction. Should these mild measures fail, they should not be persisted in for longer than a week, otherwise the persistent vomiting will so weaken the patient as to make the chances of a successful result exceedingly remote; early operative interference must be undertaken if the patient is to be saved.

The simplest method of remedying the condition is to perform an *entero-enterostomy*, *i.e.*, a lateral anastomosis between the afferent and efferent loops

of the intestine a little below the seat of the gastro-enterostomy. The result is that fluids from the duodenum readily find their way into the efferent loop without any risk of passing backwards into the stomach, and, should the stomach empty its contents into the duodenal loop, as it does in the vicious circle, these contents have only a short distance to travel before they again fall into the proper part of the intestine (see Fig. 82). The operation is done in a similar manner to that for the original gastrostomy, clamps being applied to each loop of the intestine two or three inches on either side of the proposed opening, which should be on the convex border and should be made by simple suture if possible, as it is important to keep the passage through the alimentary canal pervious from the earliest possible date. The situation of the anastomosis should be about two or three inches below the gastro-enterostomy and if this part be chosen it will be possible to pull both loops of intestine well out of the abdomen, which is packed off quite safely by abdominal cloths (see p. 177). We need not describe the operation in further detail.

It has been suggested that the Y-operation (see p. 256) should be employed for these cases, but this operation had better be the original procedure if it is to be performed at all; in the cases of which we are speaking, it is more troublesome than the lateral anastomosis, and is not really more effectual.

Of contraction of the opening.—Another serious difficulty after gastro-enterostomy is the gradual contraction of the anastomotic opening. How far this may be affected by the method employed is not quite clear. Some think, for example, that the tendency to stenosis is greater after the use of Murphy's button than after simple suture, and that the latter gives better results in this respect than any mechanical appliance. We are inclined to think that, to a great extent at any rate, this diminution in the size of the opening is not due so much to the method of operation as to the condition of the stomach before it is performed, for undoubtedly our experience goes to show that stenosis most often occurs in those cases in which operation has been performed for a greatly dilated and hypertrophied stomach, and the probability is that the gradual contraction of the orifice merely occurs *pari passu* with the diminution in volume of the organ as it returns to the original size after the obstruction has been relieved. The best way undoubtedly to avoid this stenosis is to perform the operation by simple suture, for by it the size of the opening can be regulated to a nicety, and, when the stomach is unduly dilated, an apparently excessively large opening should be made in order to allow for this subsequent contraction. This does not add at all to the danger of the operation or to its difficulty, and should never be forgotten; it cannot be done by any of the mechanical methods. This is probably the reason why contraction is said to be greater after the use of Murphy's button.

When sufficient stenosis occurs to cause a recurrence of symptoms there is nothing for it but to perform a laparotomy, and either to make a fresh

anastomosis or to enlarge the existing one. Should the original operation have been a posterior gastro-enterostomy, it is, of course, easy at the second sitting to perform an anterior one. Should the original one have been the anterior operation, however, the surgeon is often faced with a considerable difficulty. He must either make an entirely fresh anastomosis by laying some other part of the loop of the jejunum upon the anterior wall of the stomach and making a fresh anastomosis if there be room for it, or, failing that, he must make a fresh and more extensive opening; this is by no means easy to do.

TREATMENT OF ACTIVE GASTRIC HÆMORRHAGE.

The surgeon is now more frequently called in for the treatment of this condition than was formerly the case. Before considering the technique of operative interference under these circumstances, it is well to mention a few important points. In the first place, bleeding is very rarely fatal *per se*, however profuse it may be for the moment, and, secondly, most cases of active hæmorrhage from a gastric ulcer can be checked by purely medical means (for which medical text-books should be consulted), and need not necessarily recur. In the third place, if there be such severe hæmorrhage that the patient's life is jeopardised, this danger will be enormously increased by operative interference, as the shock resulting from it may be sufficient to bring about a fatal termination. Lastly, it must never be forgotten that it is by no means easy to find the source of hæmorrhage, or, when found, to treat it appropriately.

The bleeding may be derived from one of two sources, either of which may be excessively difficult to treat by operative measures. On the one hand, the ulcer may be closely adherent to and erode the pancreas, or may lie in the duodenum, or may open up the coronary or gastro-epiploic arteries. On the other hand, the bleeding may not be derived from any large vessel at all, but may proceed from one or more extensive superficial erosions of the mucous membrane, the oozing from which is exceedingly difficult to check. We should, therefore, strongly recommend that operative interference on account of hæmorrhage pure and simple should only be undertaken when the bleeding is so severe as to threaten the patient's life if it continues, and only after every attempt to check it by medical measures has proved futile, and that it should never be undertaken on the first occasion on which hæmorrhage occurs, but only when repeated attacks of severe bleeding have previously occurred.

In all cases of active hæmorrhage the patient should be first of all strictly confined to bed in the horizontal position and medical treatment should be tried. The head should be kept low and a large ice-bag (see Fig. 48) should be placed over the epigastrium. Ice may also be given freely by the mouth and a point of great importance is to keep the patient quiet and free from the visits of friends and relatives, as any quickening of the heart's action may increase the blood pressure and provoke the bleeding. While

the hæmorrhage is active, ergotine should be injected subcutaneously in doses of $\frac{1}{100}$th of a grain combined with morphine frequently repeated, or pil. saponis co. gr. 1 may be given every four hours followed by gallic acid in ten-grain doses as the bleeding diminishes. A very valuable method is to irrigate the stomach with iced water, in doing which a soft tube must be employed and great care must be exercised both in passing it and in performing the irrigation not to damage the stomach wall or to over-distend the organ. It is especially valuable when the stomach is distended with a quantity of clot. More recently, supra-renal extract has come to be regarded as a very valuable method of checking hæmorrhage from mucous surfaces. It may be given in the form of supra-renal extract (gr. v.) every three or four hours.

Operation.—When medical means fail and it is determined to open the stomach to arrest the bleeding, the most stringent precautions must be taken against shock (see Part I., p. 138) and it is especially necessary to have large quantities of hot saline solution at hand both for intra-venous and intra-abdominal infusion. All the stages of the operation must be carried out with the greatest rapidity consistent with safety; the patient should have the extremities warmly wrapped up, should be surrounded with hot bottles, and the operation should be performed in a room in which the temperature is kept at or above 75° F. The abdomen is opened by the usual incision (see p. 188) carried if necessary below the umbilicus to the left side, and the stomach is rapidly drawn out of the wound and packed off with abdominal cloths (see p. 177). Its anterior surface and greater curvature are then thoroughly examined both by sight and by touch, and, if nothing be found there, it is well to palpate the first part of the duodenum before making an opening into the stomach, as the ulcer is frequently situated there. An ulcer on the anterior surface of the stomach or in the neighbourhood of one of the curvatures is readily detected by the alteration in the peritoneal coat, by the induration around and by the loss of substance over the ulcer, which can be felt by the finger. If an ulcer be found on the anterior surface it is treated in the manner described on p. 236.

In the majority of cases the ulcers giving rise to free hæmorrhage are situated either on the posterior wall or towards one end of the stomach, and no time should be lost in trying to ascertain the position of the ulcer by touch if its whereabouts be difficult to make out. A free incision should be made into the stomach three or four inches in length parallel to the two curvatures and rather nearer to the greater than the lesser. Immediately this is done, the ends of the incision and the centre point on each side are seized in vulsellum forceps, which are held and raised by the assistants so that a large lozenge-shaped opening is formed which allows the passage of the hand and which, if sufficiently raised, prevents the escape of stomach contents. The next step is to empty the organ of its contents which mainly consist of blood; this may be done by syphoning off the fluid portion of the contents and removing the more solid part by

sponges. If a large vessel be the source of the bleeding it can often be seen spouting and filling the stomach with blood as soon as the gastric contents have been removed; a sponge upon forceps should be at once applied over the bleeding orifice so as to stop it by pressure, and the permanent occlusion of the bleeding point can be proceeded with when the stomach has been emptied. If no spouting vessel be seen, the stomach must be mopped out and the entire mucous membrane must be methodically examined, beginning with the anterior surface, which can be easily inspected by everting it through the opening and sponging each portion carefully as it is brought out.



FIG. 83.—METHOD OF EXAMINING THE MUCOUS MEMBRANE OF THE POSTERIOR GASTRIC WALL THROUGH AN INCISION IN THE ANTERIOR WALL. The hand introduced through a slit in the omentum pushes up and protrudes the posterior wall through the opening.

If, after thus examining the anterior wall, no ulcer can be seen on the posterior surface from the incision in the anterior wall, a hole may be made in the omentum sufficiently large for the assistant or the operator to introduce a hand along the posterior wall of the stomach, and thus to push up the mucous membrane through the opening in the anterior wall (see Fig. 83). This is quite an easy matter as long as there are no adhesions fixing the posterior surface, and by its means the entire posterior wall may be examined carefully. If no ulcer be found in this situation the finger should

be pushed through the pyloric opening which, if of normal calibre, should admit it freely; if it be too contracted to admit the finger or if an actual ulcer be felt in that situation, either the incision in the anterior wall may be prolonged up to the pylorus or, if the patient's condition be bad, an anterior gastro-enterostomy may be done (see p. 276).

If however nothing be felt in the pylorus and the finger readily pass through it, the first part of the duodenum should be examined and an ulcer felt for in that situation. Finally, if this examination fails to reveal the presence of an ulcer, the cardiac end should be inspected by introducing a large broad retractor within the stomach and pulling up the liver and the costal margin. If now a strong light be thrown into the interior of the organ the cardiac orifice can easily be seen. It is most important to perform all explorations of the stomach in this methodical manner whenever the ulcer is not at once visible, as a great deal of time is eventually saved by its means. In many cases however the situation of the ulcer is clear directly the stomach has been emptied, as a spouting vessel may be seen, or the hard, ulcerated surface may be felt, or the source of the blood may be made out by watching the direction from which it trickles. The methodical examination of the mucous membrane of the stomach is particularly useful in cases of superficial ulcers or erosions which bleed freely but give rise to no induration at all, and which cannot therefore be felt with the finger.

Treatment of the bleeding spot.—*Should the ulcer be on the anterior surface* and not be adherent to adjacent structures, the best method of arresting the hæmorrhage is to excise the ulcer, which is done in the manner already described (see p. 236) In all these cases of course it is theoretically advisable to perform a gastro-enterostomy so as to insure the cure of the ulcer and to prevent recurrence, but, as many of these patients are hopelessly broken down in health, the shock of such a procedure might prove fatal, and it will be necessary, in a considerable number of cases at any rate, to be content with excising the ulcer and trusting thus to cure the disease.

When the ulcer is on the greater curvature of the organ the bleeding will come from one of the gastro-epiploic vessels, and the simplest plan of arresting it is to clamp the main vessel externally on each side of the site of the ulcer; the latter is then excised (see p. 236) along with any indurated portion of the omentum about its base. The incision through the omentum should be triangular in shape with its apex downwards and its base corresponding to the ulcer on the curvature (see Fig. 84). When the opening thus left is sutured, one or two stitches are made to close the opening in the omentum. It may however happen that the induration is so extensive that excision of the ulcer is impossible and, under these circumstances, ligature of the coronary or gastro-epiploic artery concerned will usually suffice to stop the bleeding. This may be done by passing an aneurysm needle around it or by underrunning it with a needle threaded with catgut. In all these cases the question of performing a gastro-enterostomy or a pyloroplasty in addition to or instead of excising the ulcer

will have to be considered, and the decision will depend mainly upon the patient's condition, as although it is undoubtedly advantageous to combine one of these operations with excision of the ulcer (see p. 237) it is nevertheless often impracticable owing to the debilitated condition of the patient. When choice is possible gastro-enterostomy should be preferred to pyloroplasty.

When the ulcer is situated on the posterior surface and is adherent to the pancreas, as is not infrequently the case, the large pancreatico-duodenal vessels may be opened and free and even fatal hæmorrhage may result. Under these circumstances the spouting vessel will generally be seen when

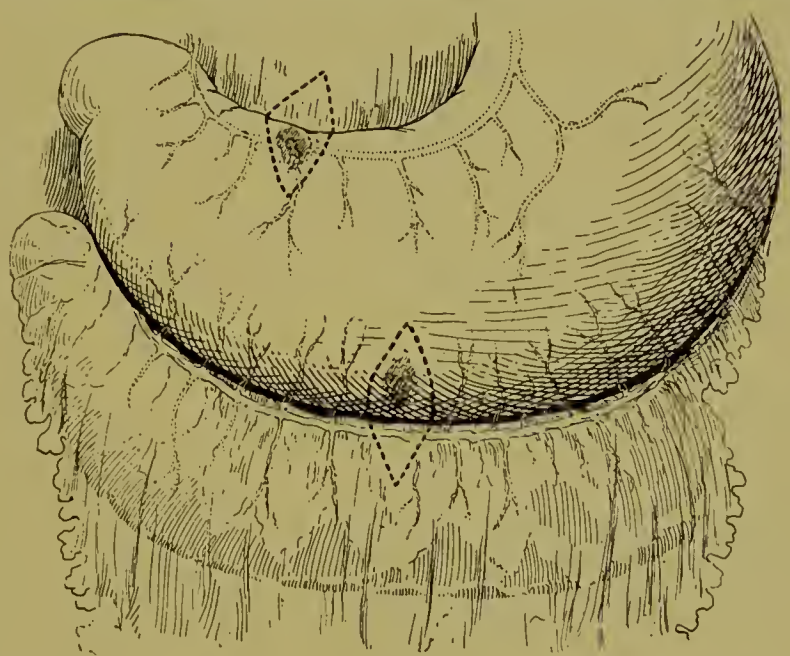


FIG. 84.—METHODS OF TREATING ULCERS SITUATED AT THE CURVATURES OF THE STOMACH. The shaded areas indicate the position of the ulcers, and the dotted lines are the lines for excising them. These are partly through the stomach walls and partly through the omenta. By their means it is possible to bring the divided edges together without difficulty.

the stomach is opened and can be stopped temporarily by pressure until the stomach contents are completely evacuated. The difficulty is to treat the ulcer. Attempts have been made to excise these ulcers by introducing the hand along the posterior wall through a slit in the omentum and gradually separating the ulcer from the pancreas, but the adhesions are generally so extensive that this cannot be done and, further, the patient's condition is probably so bad that time is of urgent importance. The most that usually can be done is to pick up the vessel and tie it or, if this be impossible, to arrest the bleeding by applying the actual cautery to the bleeding point, or even to under-run it with stout catgut and tie it and a portion of the pancreas *en masse*. As a rule the exact point from which the bleeding is coming is very difficult to see and the best plan of under-running it is to pass one or two sutures deeply through the wall of the ulcer and to tie them tightly together so as to compress the surfaces of

the ulcer one against the other and thus occlude the bleeding point. A gastro-enterostomy should then be performed, and the simplest plan is to utilise for the purpose the incision already made through the anterior wall of the stomach.

When the hæmorrhage comes from an ulcer of the pylorus or the first part of the duodenum, the simplest plan is to perform a gastro-enterostomy. The patient will certainly not be in a condition for excision of the ulcer either alone or combined with excision of the pylorus and, unless there be actual erosion of a considerable vessel, the bleeding will almost certainly stop when the gastric contents cease to pass over the ulcerated surface.

When the bleeding is a very free oozing from the mucous membrane or when no bleeding point can be found, a gastro-enterostomy will usually suffice. The cautery applied at a dull red heat to a simple erosion will sometimes check the bleeding from it, but usually the best plan is to insert ice into the stomach, and to perform a gastro-enterostomy, utilising the incision in the anterior wall of the stomach for the purpose. Supra-renal extract (gr. v.) dissolved in a little water may be introduced into the stomach and left there as the anastomosis is made, and a second dose may be given if necessary, to check oozing, as soon as the patient recovers from the anæsthetic.

From the nature of things it cannot be expected that the rôle of surgical intervention for the purpose of saving a life imperilled by severe bleeding is likely to be a very brilliant one as the condition of the patient must necessarily be so unsatisfactory. Indirectly however hæmorrhage is treated by surgical means with very great success, namely in those cases where the bleedings are small and repeated and threaten, if allowed to persist, to endanger the patient's life. These cases really fall under the first group already described (see p. 233). In nearly all cases, when called upon to interfere for active hæmorrhage, the surgeon will find that the actual bleeding is checked by medical means, but that the hæmorrhages are so free and so often repeated that something must be done to stop them permanently. Under these circumstances it is best to wait for a short time until the patient has to some extent recovered from the immediate loss of blood; but if the hæmorrhages are repeated daily or every two or three days this is not permissible and excision of the ulcer, gastro-enterostomy or both must be practised immediately.

TREATMENT OF CONTRACTIONS AFTER HEALING OF AN ULCER.

Here the surgeon has to treat not the ulcer itself but its sequelæ, for the ulcer may have healed, and the patient's symptoms be entirely those caused by the cicatricial contraction consequent upon this. One of two conditions may require remedy—stenosis of the pylorus or constriction of the stomach itself, which usually takes the form known as "hour-glass contraction." The surgeon has three methods at his disposal for the treatment of this condition,

viz., division of the constriction, complete excision of it, or the formation of a fresh anastomotic opening so as to throw the constricted portion out of the intestinal circuit.

Treatment of Stenosis of the Pylorus.—The first proposal for treating this condition was made by Loreta, who forcibly dilated the pyloric orifice with instruments or the finger passed through it from an opening in the stomach until the original lumen of the canal was restored. The operation has been modified so as to dilate the pylorus without opening the stomach by invaginating a portion of the walls of the latter over the finger and gradually forcing this invaginated portion through the thickened pylorus. This modification however must be utterly condemned, because very serious results may follow the bruising of the invaginated portion of the stomach that must necessarily occur if the contraction of the pylorus be at all marked. Loreta's operation has not justified the great hopes that were first raised by it; experience shows that, as in strictures of other canals, contraction certainly recurs and, after a few weeks or a few months, the patient's condition is as bad as ever. Accidents have also happened at the time of the operation from splitting of the cicatricial contraction and actual perforation, and this has practically led to the abandonment of the operation, which we shall therefore not describe. In cases of obstruction of the pylorus at the present time the surgeon has a choice between excision of the pylorus or pylorectomy, pyloroplasty and gastro-jejunostomy. In some cases gastro-duodenostomy may be done, but gastro-jejunostomy is the usual form of short-circuit operation.

Pylorectomy is a much more severe operation than any of the other procedures, and in these particular cases it is rendered exceedingly difficult and dangerous, because the adhesions in the neighbourhood of the pyloric orifice are usually numerous. We do not therefore think that the operation is justified for a simple stricture of the pylorus.

Pyloroplasty is certainly suited for some cases, but probably not for so many as was at one time supposed. Some cases are undoubtedly very difficult to treat in this manner, whilst probably in the majority some subsequent contraction must gradually take place even when the enlargement of the canal has been satisfactorily accomplished at the time of the operation. In narrow annular strictures however this operation is very suitable; the operation has been already described (see p. 238).

Gastro-jejunostomy is called for when there is much cicatricial tissue, involving a very long incision, and at the same time rendering the approximation of the edges of the wound difficult by pyloroplasty. The posterior form of the operation (see p. 247) should be chosen to avoid the risk of a vicious circle, and, if the opening be made sufficiently large, the result is extremely satisfactory.

Gastro-duodenostomy or the anastomosis of the duodenum with the stomach, is only suitable for such extensive dilatation of the stomach that the approximation is not difficult. As a rule the operation is neither so easy

nor so satisfactory as gastro-jejunostomy. It is performed by bringing over a portion of the anterior surface of the first part of the duodenum to the anterior surface of the dilated stomach and anastomosing them in the usual manner.

Treatment of "hour-glass contraction" of the stomach.—The surgeon has at his disposal the operations of gastroplasty, gastro-gastrostomy, (see Fig. 85) or gastro-jejunostomy. Of these the operation of choice is gastroplasty, but this can only be done when the constriction between the two portions of the stomach is the chief mischief and is not accompanied by extensive induration or distortion of the surrounding stomach wall.

Gastroplasty.—An incision three or four inches long is made in the anterior wall of the stomach parallel to the curvatures and extending at least an inch beyond each end of the constriction between the two portions of the organ. The incision is carried into the interior of the stomach just beyond one end of the stricture, and the constriction is divided either by pushing a probe-pointed bistoury or a pair of probe-pointed scissors along the narrow portion so as to divide the stricture throughout. This longitudinal incision is now converted into a transverse one by approximating the ends of the incision in the first place with Halsted's sutures (see p. 215); if there be little tension, but fairly free oozing, a continuous stitch taking up all the coats of the stomach may be inserted instead. Outside the first line of sutures a continuous sero-muscular suture of fine silk completes the closure (see Fig. 85, *A*).

The only objection to this operation is the tendency to recurrence afterwards, which is due to two main factors. In the first place there is a diminution in the artificial opening thus made as the cicatrix contracts. In the second place adhesions are very likely to form as the result of the manipulations about the stomach and this may greatly interfere with the functional result. The first objection can be met to a considerable extent by making the incision into the stomach long enough to give a wide opening so that little fresh constriction can occur between the two portions of the stomach. The second objection, namely, the formation of adhesions, can only be met by performing the operation as quickly as possible and by taking care that the surface of the organ is not irritated mechanically by sponges or chemically by antiseptics of any sort.

Gastro-gastrostomy.—When the stomach is divided into two large and distinct sacs the operation of gastro-gastrostomy has been performed (see Fig. 85). In this the actual constriction is left alone and the dilated portions on either side are united by an ordinary lateral anastomosis, usually below or in front of the seat of constriction. The anastomosis is made by simple suture and a glance at Fig. 85, *B*, will explain its mechanism. The operation is really not very satisfactory and is only of use when the constriction is merely a part of very extensive thickening of the gastric walls which renders it impossible to do a satisfactory gastroplasty.

Partial gastrectomy.—It has been proposed that, when the distal portion of the constricted stomach is very small, a partial gastrectomy should be performed; in other words, the distal portion of the stomach with the stricture is removed and the proximal sac has implanted into it the divided end of the duodenum. This is a severe operation, which is comparable to pylorectomy (see p. 289) to which it is very similar in its steps, and it offers no particular advantages over other methods. Another suggestion has been that,



FIG. 85.—METHODS OF TREATING AN "HOUR-GLASS CONTRACTION" OF THE STOMACH. *A* and *A'* show the two stages of gastroplasty, *B*, *B'* and *C*, *C'* the stages of gastro-gastrostomy under different conditions, while *D*, *D'* shows partial gastrectomy combined with subsequent gastro-gastrostomy, the shaded portion being the part excised.

when the constriction between the two portions is very considerable and there is much induration, the whole constricted area should be excised and the two halves of the stomach reunited (see Fig. 85, *D*). This again is open to the objection that it is a very serious operation in that it is extremely difficult to protect the abdominal cavity from soiling by the gastric contents. Moreover the area requiring suture is very extensive and the approximation must be extremely good.

Gastro-jejunostomy.—This operation is of course very effectual in establishing the intestinal circulation, but, as it puts out of use the distal portion

of the stomach, which may be large, it should not be performed except when gastroplasty or gastro-gastrostomy are not applicable. It will chiefly be employed for the cases in which the anterior surface of the stomach is markedly deformed by adhesions from perigastritis due to extensive or multiple ulcers. Plastic operations upon the stomach under these circumstances are liable to give rise to disappointment, as the adhesions are very inveterate and the distortion may even be increased by operation.

With regard to the question of the performance of gastro-jejunostomy, it is well to remark that it has happened more than once that the anastomosis has been made between the distal portion of the stomach and the jejunum instead of between the latter and the proximal half. This is particularly prone to occur when the constriction of the stomach is near the cardiac end, and the result is of course that the patient obtains no relief and either dies or requires a second operation. Consequently the surgeon must make quite certain of the topography of the stomach and must not mistake a somewhat constricted pylorus for an hour-glass contraction of the stomach. This accident has occurred in the hands of most competent surgeons, and it has also happened that mistaking of the pylorus for the stricture has led to a pyloroplasty instead of a gastroplasty being performed with the result again that the actual stomach constriction has been unrelieved.

TREATMENT OF PERFORATED GASTRIC ULCER.

In this group of cases surgical aid should always be invoked at the earliest possible moment. The symptoms of sudden perforation of a gastric ulcer are not always constant or typical. They consist of sudden acute localised pain, accompanied by exquisite tenderness and local rigidity of the abdominal wall followed rapidly by marked collapse, accompanied by vomiting and diffusion of the pain, tenderness and rigidity over the whole abdomen. There may be also signs of gas free in the peritoneal cavity as shown by loss of liver dulness, and, if the perforation be large and the amount of gastric contents extravasated great, there will be dulness from the collection of fluid in the most dependent situations. The patient has the typical anxious countenance, the collapse is profound and a long interval elapses before any sign of reaction occurs.

The occurrence of perforation of the stomach is followed within a very short time by signs of steadily increasing acute general peritonitis. In this connection it is well to remember that symptoms very similar indeed may arise in neurotic patients and it has happened more than once that the stomach has been cut down upon in these subjects on the diagnosis of a perforated gastric ulcer without anything of the kind having been found. Curiously enough the cases thus treated have at once recovered from their stomach symptoms.

In the great majority of cases the perforated ulcer lies on the anterior wall of the stomach, something like 80% of all cases of perforation being

due to ulcer in this situation. The actual perforation is usually a very minute aperture in the first instance which forms in the peritoneal coat over the base of the ulcer; sometimes however the opening may be considerable. An ulcer situated anywhere on the stomach may give way and perforate, but when this occurs through the posterior wall, or when adhesions have so shut off the general peritoneal cavity that no extravasation takes place into it after the ulcer has perforated, the symptoms may be extremely slightly marked.

When a gastric ulcer perforates into the abdominal cavity it gives rise to either local or general peritonitis. When the opening is fairly large and there are no adhesions, general peritonitis sets in and, if left alone, is practically always fatal. When some adhesions exist which are not enough to actually shut off the ulcer in all directions but are sufficient to shut off the surface of the stomach more or less from the general abdominal cavity, there is a localised peritonitis which practically always ends in suppuration and gives rise to the condition known as sub-phrenic abscess, which will be separately described (see Chap. XXI.); an ulcer of the stomach is a fairly common cause of this condition.

When perforation into the general peritoneal cavity has occurred it is clear that the only chance for the patient is an immediate operation designed on the one hand to close the opening in the stomach and on the other to remove the septic materials which are soiling the peritoneum. The success of this operation depends to a very great extent on the length of time that has elapsed between the occurrence of the perforation and the performance of the laparotomy. After the first twelve hours the mortality increases enormously and very few cases indeed recover in which general peritonitis has manifested itself. Hence, if there be any doubt as to whether there be a perforation, it is far better to open the abdomen early than to wait until the diagnosis is placed beyond doubt, in other words until marked symptoms of peritonitis have set in. At the same time it is no doubt well to wait an hour or so after the onset of the perforation in order to allow the patient to rally somewhat from the profound shock to which the act of perforation always gives rise. After the lapse of three or four hours however no further delay should take place.

Preliminaries.—The shock is always intense and every means must be taken to shorten the operation and all the other measures for combating shock should be had recourse to (see p. 177).[1] The anæsthetic employed should be ether. The skin should be purified as rapidly as possible and the abdomen opened by a free incision from the xiphoid cartilage to the left of the umbilicus in the manner already described (see p. 188). The peritoneum must be opened with care as the presence of an ulcer on

[1] The steps necessary to reduce the shock of the operation are not given here in order to save much repetition as they are identical with those employed for rupture of the stomach. They are however among the most important points in the operation and should on no account be neglected.

the anterior wall of the stomach may have led to adhesions between the latter and the parietes.

Finding the perforation.—Usually the diagnosis is confirmed immediately the abdomen is opened, as gas and sour-smelling gastric contents freely escape from the opening. Whether this be so or not, the incision is widely retracted with broad retractors, abdominal cloths are packed in at the lower angle of the wound and on either side, and the stomach is drawn gently out of the wound and packed behind with other abdominal cloths. In the majority of cases the ulcer is seen without any difficulty as it is upon the anterior wall; if however it be not there, the pyloric region and the first part of the duodenum should be next examined as the ulcer not infrequently is situated there. Failing these regions, the cardiac end of the stomach should be examined both by sight and by touch. As a rule the seat of the ulcer is easily detected, as slight pressure on the abdomen or the stomach causes gas to bubble out at the opening; this bubbling can be both heard and seen.

Should no ulcer be found on the anterior surface, the posterior wall of the stomach is examined in the way already described (see p. 273). As a rule however perforation in this situation does not give rise to acute general peritonitis and is only operated upon secondarily. Extravasation of the contents of the stomach takes place into the lesser cavity of the peritoneum, which becomes shut off from the general peritoneal cavity. Suppuration occurs and an abscess forms which may point in various situations, the most common being the so-called sub-phrenic abscess, which will require to be opened and drained; this subject is dealt with separately (see Chap. XXI.).

Cleansing the abdominal cavity.—The perforation should be closed temporarily by compressing and covering it with an abdominal cloth while the surgeon turns his attention to the removal of the extravasated material from the peritoneal cavity. This must be done systematically, and the steps of the procedure are so exactly similar to those for rupture of the stomach (see p. 209) that they need not be recapitulated here. The reason that the cleansing of the peritoneum is undertaken before the repair of the perforation is the same as in the case of rupture of the stomach, *i.e.*, that it is of the greatest importance to rid the peritoneal cavity of the irritating and septic material at the very earliest possible moment. It is of the highest importance that this stage of the operation should be carried out with the greatest thoroughness. The lines laid down on p. 209 should be scrupulously followed.

Closure of the perforation in the stomach.—Attention is next directed to the permanent closure of the perforation in the stomach. The simplest plan is to invaginate the stomach wall and to suture the opposing surfaces with a continuous sero-muscular suture. This is difficult however in many cases as there is so much induration around the edge of the ulcer that it is impossible to invaginate neatly. In the majority of cases therefore it will probably be better to excise the ulcer, especially when it is of limited

extent and has an indurated base; the edges of the elliptical wound thus made may be sutured as recommended for excision of a simple ulcer (see p. 237) or, if time allows, may be used for a gastro-enterostomy.

In the rare cases in which the ulcer is extremely large and its walls are so dense and thickened that they will neither invert nor can they be safely excised, it has been proposed to close the opening by turning up a portion of the omentum and fastening it over the base of the perforated ulcer with catgut stitches. To this should be added, if the patient be in a condition to bear it, a posterior gastro-enterostomy, which may be rapidly done with Murphy's button or with Robson's bobbin, and will give the patient a good chance of recovery. This plastic method of covering up the perforation with a portion of omentum is also particularly applicable to ulcers in the neighbourhood of the first part of the duodenum. Any perforation on the posterior surface of the stomach is either sewn up or excised; in the latter event the opening thus made is utilised for the performance of a gastro-enterostomy.

Drainage.—In closing the abdomen the question of drainage will arise and here the remarks made on this point in reference to rupture of the stomach (see p. 215) are applicable. While tubes introduced into Douglas' pouch or the flanks can do no real good, it is distinctly advisable to insert a drainage tube that runs down into the immediate vicinity of the ulcer; this is a point of some considerable danger as it is possible that septic infection of the peritoneal surface in its immediate neighbourhood has occurred which neither irrigation nor sponging will remove. It is even more possible that under certain circumstances the line of union may give way and a second fatal extravasation might take place if there were no drainage. In this respect therefore the insertion of a drain which goes down to the immediate neighbourhood of the ulcer, that is to say to the anterior surface in the ordinary cases, or into the lesser cavity of the peritoneum if the ulcer be situated on the posterior surface, is a measure that has much to recommend it. The best plan is to employ a drainage tube packed round with gauze and this need only be left in for two or three days as adhesions rapidly form around it and will shut off the region that is to be drained from the rest of the peritoneal cavity and will therefore make the latter safe.

After-treatment.—This will be absolutely identical with that for rupture of the stomach (see p. 217). The drainage tube is withdrawn at the end of two or three days if no unfavourable symptoms arise, and the opening in the abdominal wall through which it has passed should be obliterated by tying the loose stitch which should be left long at the time of the operation (see p. 218).

TREATMENT OF SYMPTOMS DUE TO GASTRIC ADHESIONS.

The surgeon is not infrequently consulted when the history points to the previous existence of a gastric ulcer but where the existing symptoms

take the form of dyspepsia with much pain or distension after meals, constipation, etc. If these symptoms cannot be remedied by appropriate medical treatment, the surgeon may be asked to perform an exploratory laparotomy, and will then often find the symptoms due to old perigastritis producing adhesions which either partially obstruct the stomach itself or give rise to adhesions between it, the liver, the gall bladder or the transverse colon, etc. We have already referred to the more marked and limited adhesions ending in stenosis of the pylorus and hour-glass contraction of the stomach. The adhesions to which we refer here are of a different character and do not actually interfere with the intestinal circulation as they do not produce any constriction. Their effect is more to give rise to uneasy feelings and disturbances after food or on movement of the intestines, owing to the fact that they anchor the organ to adjacent parts. Quite a number of cases of apparently confirmed dyspepsia have been improved or even entirely cured by opening the abdomen and finding and dividing adhesions of this kind.

The operation of course takes the form of an exploratory laparotomy; any adhesions that are found are separated and the stomach is freed in any manner that may seem necessary. Sometimes the adhesions take the form of long, thin bands crossing, for instance, from the stomach to the liver and preventing increase in size downwards when the former organ is distended. Sometimes they pass between the stomach and the colon; sometimes the stomach, liver and colon are all united by a thick fibrous band. These bands may also become stretched in time and form cords which are a constant potential cause of intestinal obstruction. The removal of as much of the bands as possible is the proper treatment; it is not right merely to divide the band and leave the ends free, as they may contract fresh adhesions and become a source of trouble a second time. They should be divided if possible at their extreme points of attachment and the whole of the intermediate portion removed. Many of the adhesions will require ligature before they are divided. In cases of this kind the operation should effect a complete cure.

In other cases broad extensive adhesions are met with which are much more difficult to separate, and which, when separated, leave large raw surfaces behind that are unfortunately only too prone to contract fresh adhesions. These cases are often extremely disappointing; the immediate results are very brilliant, but, as time goes on, the old symptoms gradually reappear as the fresh adhesions contract. At the same time the operation is always worth doing as the adhesions may not re-form in exactly the same way and the troublesome symptoms may be relieved. It is well during healing to try, by putting the patient into suitable positions, to prevent recurrence of the same sort of adhesions as before. For example, if the stomach and colon be found tucked up under the liver, the patient may be propped up in bed after the first 12 hours so that the stomach falls downwards, or if necessary he may actually sit up or may lie upon one side so as to separate

the raw surfaces left as far as possible; particular care must of course be taken to secure thorough stitching of the abdominal wall. The actual management of these cases cannot be described in detail as everything depends upon the particular circumstances met with. In all operations for adhesions special care is necessary to manipulate the abdominal cavity as little as possible and never to allow antiseptics to come into contact with the peritoneal surfaces, as otherwise further adhesions are inevitable

GASTROPLICATION.

This operation may be mentioned in this connection although it strictly does not apply to cases in which there is ulceration of the stomach. Occasionally the organ may be markedly dilated without any great pyloric constriction or perigastric adhesions. These cases are said to

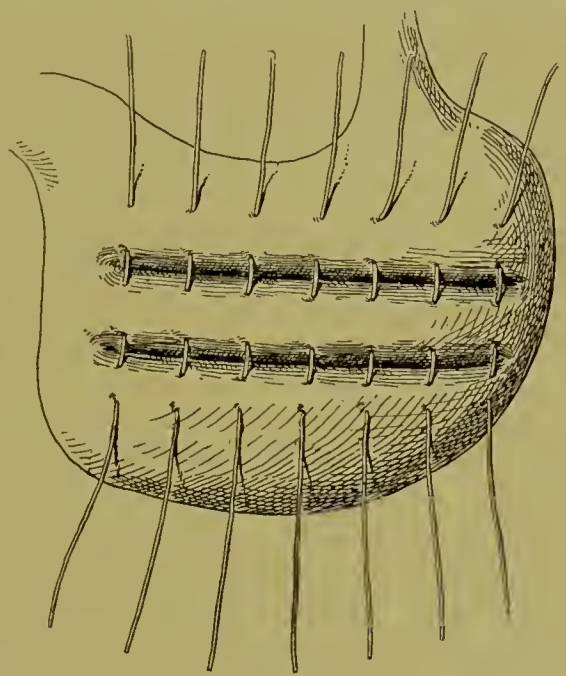


FIG. 86.—GASTROPLICATION. The corresponding ends of the sutures—which are sero-muscular—are tied together and pleat up the stomach wall.

be due to an atonic dilatation of the viscus from defective power or to dilatation resulting from frequently recurring spasm of the pylorus, and for the relief of this the operation known as gastroplication has been suggested; the nature of this is sufficiently indicated by the diagram (see Fig. 86). It pleats up the stomach wall with sutures so that the opposed serous surfaces adhere and mechanically diminish the size of the organ. We have no personal experience of the operation, and do not think that it is likely to be much practised.

CHAPTER XV.

CANCER OF THE STOMACH.

BENIGN growths may occur in the stomach but they are mere pathological curiosities, and the diagnosis is rarely made until after death or until after an exploratory laparotomy. The tumours met with have been generally myomata or fibromata, the former being the more common. The treatment of course should be excision, and the only point of importance to bear in mind is that when an anomalous tumour of the stomach wall is met with it should not necessarily be set down as malignant. The most common malignant tumour of the stomach is undoubtedly a carcinoma Sarcoma of the stomach, although occasionally met with, is an extreme rarity. We shall therefore confine our remarks entirely to the carcinomatous form.

Carcinoma of the stomach is a very frequent form of malignant disease, about 2% of all deaths from cancer occurring from this affection. Men and women appear to be affected in equal proportions and the disease is most common between forty and sixty years of age, and is said to be more prevalent in the tropics than in temperate climates. It is almost invariably a primary lesion but is sometimes secondary to carcinoma of the œsophagus, pharynx or breast.

Amongst predisposing causes a pre-existing ulcer of the stomach is very important. The neighbourhood of the pylorus is the most common situation of the affection, about 60°/₀ of all cases starting in that region. The growth is usually a cylindrical epithelioma; the lymphatic glands are affected comparatively early, the first to be involved being those along the lesser curvature and those running up into the region of the liver. Before long however the glands in the omentum and about the pancreas enlarge and the latter is a point of the greatest practical importance, as glands in this situation are extremely difficult to remove satisfactorily. The disease may involve the liver, spleen or pancreas by direct continuity, and occasionally the case terminates by a general cancerous infection of the peritoneum.

SYMPTOMS.—The symptoms will vary according to whether or not there be obstruction to the passage of food.

When the growth is situated near the pyloric end of the stomach there is a gradually increasing obstruction to the passage of the gastric contents accompanied by dilatation of the stomach in addition to the symptoms proper to the growth.

When the growth is situated at the cardiac end, the entrance of food into the stomach is greatly hindered and the symptoms are practically those of œsophageal obstruction.

When the growth is situated in the body of the organ the symptoms proper to cancer of the stomach are chiefly in evidence. These are very severe pain and dyspeptic symptoms combined with the most profound mal-nutrition. The patient is sallow and anæmic, loses flesh rapidly and suffers to a marked degree from the cancerous cachexia. Vomiting is frequent, and the contents of the stomach show altered blood and a remarkable absence of free hydrochloric acid. This latter sign is one of the most marked symptoms of cancer of the stomach and is a very valuable diagnostic point in deciding between it and gastric ulcer. The entire gastric mucous membrane is in a condition of chronic catarrh and rapidly atrophies. The free hydrochloric acid rapidly disappears and its place is taken by lactic acid resulting from the fermentation of the stomach contents, which have also a peculiarly offensive odour.

Sometimes the tumour is felt through the abdominal wall but this is not always the case, either because the growth is small or because the organ is drawn well up under the liver. Occasionally the weight of the tumour drags the stomach down into the abdomen and it is then quite easily felt. When the growth is situated at the pyloric end it is generally small but when on the anterior surface of the stomach it may attain a considerable size; when at the cardiac end the growth cannot as a rule be felt unless it be very extensive indeed.

TREATMENT.—The treatment of cancer of the stomach may be either medical or surgical. Medical measures will be required for the relief of pain when the patient is obviously beyond the reach of surgical interference. Surgical measures may be radical or palliative. By radical surgical measures are meant complete extirpation of the growth and any infected glands, whilst the palliative means are those which aim at allowing the patient to live until death occurs from some cause other than starvation or obstruction.

In considering the treatment suitable for cancer of the stomach it is best to divide it up according to the situation of the disease. Thus, the treatment of cancer of the body of the stomach not causing obstruction at either orifice, the so-called non-obstructive cancer of the stomach, will be considered first; after that will come cancer of the pyloric end; and finally the treatment of the disease when situated near the cardiac end.

1. **Of non-obstructive cancer of the stomach.**—Here the growth is usually either on the anterior surface of the stomach or on the lesser curvature, and, when it is small and unaccompanied by glandular enlarge-

ment or adhesion to surrounding structures, it may be possible to extirpate it with a fair prospect of cure. It must however be admitted that the number of cases that come under observation in which this is feasible is extremely small. This is due to the fact that they are in the first instance watched for some time before being sent to the surgeon, largely no doubt because, when the growth is small enough to be easily removed, no tumour can be felt from outside and the diagnosis is therefore uncertain.

Gastrectomy.—It must be confessed that extirpation of portions of the stomach for cancer—*partial gastrectomy*—is not a very hopeful procedure. This depends not so much upon the fact that the operation in itself is severe, because the most extensive operations, even involving a resection of the entire stomach, have been performed without the patient succumbing, but on the fact that the growth rapidly disseminates through the stomach wall, and recurrence after these partial operations is almost invariable.

If radical measures are to be undertaken with any hope of avoiding recurrence they will probably have to take the form of excision of the entire stomach, or the larger portion of it—practically *complete gastrectomy*. Although the entire stomach has been removed for cancer with temporary success, we cannot think that the number of cases in which this can be done will be large, nor do we look upon the operation as at all a favourable one. The chief objections are that in cancer involving a large part of the stomach the disease is very likely to be extensively diffused both through the neighbouring glands and through structures that have become adherent to the stomach, and we doubt if it be wise to attempt this extremely radical operation. We shall not therefore describe the operation for complete gastrectomy, holding as we do that, if the growth be sufficiently large to warrant such a severe procedure, it is practically beyond hope of immunity from recurrence, so that, even if the patient were to recover, his misery would only be prolonged for a very short period; in fact, we should advise that, if glands be found infected to any extent, extirpation of the primary growth should not be attempted, and palliative measures should be adopted instead. In connection with the presence of enlarged glands associated with an ulcer of the stomach of suspected malignant origin, it is important to remember that these may be met with not only in cancer but also in simple ulcer of the stomach, and considerable confusion may arise under certain circumstances. For instance, when the exploratory laparotomy has been done for what is supposed to be cancer of the stomach and an indurated mass is felt on the anterior wall and large glands on the lesser curvature, it does not by any means follow that the case is one of malignant disease, as it may be merely a simple ulcer of the stomach with considerable induration about the base and secondarily enlarged glands. The question may be settled by dissecting out one of the glands and making a rough examination.

Should it be found on performing an exploratory laparotomy that the growth is so large or so extensively diffused over the surface of the stomach

as to negative a radical operation, the best plan is to close the abdomen without doing anything further. It has been suggested that, when the disease in the stomach is so extensive as to prevent the patient taking food, the operation of duodenostomy, or preferably jejunostomy, should be performed. Certainly this can be done if the patient wishes it, and may prolong his life for a few weeks, but it is questionable whether it is really worth while, and we do not advise it.

2. Of cancer obstructing the pylorus.—Here operation is urgently called for owing to the inability of the stomach to pass on its contents, and on account of this the surgeon is frequently called in at a comparatively early stage of the disease. There is a fairly wide choice of methods at the disposal of the surgeon under these circumstances: 1. excision of the pylorus and the growth followed by union of the divided end of the duodenum with the stomach,—*i.e.* pylorectomy combined with gastro-duodenostomy; 2. the growth, if too large to be removed, may be left intact and a short circuit established by a gastro-enterostomy; 3. failing either of these procedures, a permanent duodenostomy or a jejunostomy will prevent the patient dying of starvation.

In deciding upon which of these methods to adopt, the first of course to be considered is pylorectomy, since that operation gives the patient a chance not only of relief from the obstruction but of getting rid of the disease for at any rate a considerable period. The points that would decide us in favour of a pylorectomy are first of all that the tumour should be limited and small, that the pylorus should be movable, that there should be no enlarged glands in the portal fissure, in the neighbourhood of the lesser curvature or the great omentum or, if present, these glands should only be very few in number and quite movable; lastly, the condition of the patient should be such as to enable him to stand an operation that must necessarily be of considerable severity. Against pylorectomy on the other hand is extensive disease involving not merely removal of the pylorus but the greater part of the stomach, great involvement of the glands, so that some must be left behind, numerous adhesions of the pylorus to the surrounding structures showing that the disease has passed the limits of the stomach, or such a feeble condition of the patient as not to warrant a prolonged operation. It must never be forgotten that pylorectomy is a severe operation which the surgeon is not justified in performing unless the lesion be so limited that there is a reasonable prospect of a cure. On the other hand, a palliative gastro-enterostomy is an operation that is comparatively simple and safe and is sure to relieve the patient of a great deal of his trouble. The operation of pylorectomy or pyloro-gastrectomy, or partial gastrectomy, as it is more fitly called, is done as follows:

Pylorectomy.—Before proceeding to operate, a short time may be devoted with great advantage to preliminary treatment, as these patients, when they first come under notice, are almost invariably suffering from extreme

mal-nutrition. Whether this preliminary treatment should be adopted, and the length of time for which it should be followed, will depend entirely upon the degree of stenosis of the pylorus; if this be very great, little or nothing is to be gained by preliminary treatment as absorption from the stomach, even of highly digestible substances, is very feeble owing to the catarrhal and atrophic condition of the mucous membrane, while attempts to feed the patient by the rectum almost invariably end in a short time by producing an irritation that it is important to avoid as the patient must depend almost entirely on rectal feeding for the first few days after the operation. If however the stenosis be slight, it is very advantageous to devote a week or so to feeding the patient with highly digestible, concentrated, nutritious food, such as soups, peptonised milk and meat juice, whilst the stomach should be washed out daily to get rid of any fermenting contents, and this should be repeated twice a day for two days before the operation and an irrigation should be practised immediately before the anæsthetic is given. The washing-out may be done with boracic lotion and at the end of each 10-15 grains of salol may be introduced and left in the stomach.

The anæsthetic employed for the operation should be ether or the A.C.E. mixture. The incision should be a little to the right of the middle line and sufficiently free to give thorough access. It will generally require to be carried from the xiphoid cartilage to below the umbilicus. A transverse incision through the right rectus has been recommended in order to expose the tumour thoroughly when there is much fixation of the pylorus, but this is really unnecessary, for the cases accompanied by fixation of this structure are quite unsuited for removal. All the precautions against shock already mentioned in connection with severe abdominal operations (see p. 208) must be rigidly adhered to.

The first point on opening the peritoneal cavity is to search for the pylorus and to ascertain its mobility and the presence or absence of adhesions to surrounding structures. The next point is to examine for enlarged glands. The posterior surface of the pylorus must be thoroughly explored and this can be done by tearing a hole in the lesser omentum immediately above it and introducing the finger behind so as to examine its posterior surface. This also allows the posterior surface of the stomach and the pancreas to be examined and the presence or absence of enlarged glands in front of the vertebræ or over the pancreas can be made out.

When this has been done and the operation has been decided upon, the first step is to insure proper liberation of the pylorus. The edges of the abdominal wound are widely retracted, the general peritoneal cavity is carefully packed off with abdominal cloths (see p. 177) and the pylorus is freed by dividing the great omentum between two pairs of long clamp forceps (see Fig. 87). The vessels in the omentum can be afterwards tied separately or *en masse* when the pylorus has been removed. The lesser omentum as a rule can be divided by simply tearing it away with the finger if care be taken

to keep close to the pylorus ; any bleeding vessels can be picked up as they are divided. A point of very great practical importance is not to divide either of the omenta further along the stomach than the proposed line of incision in the wall of that organ, as otherwise the blood supply of some of the remaining portion of the stomach or intestine may be damaged and gangrene may result.

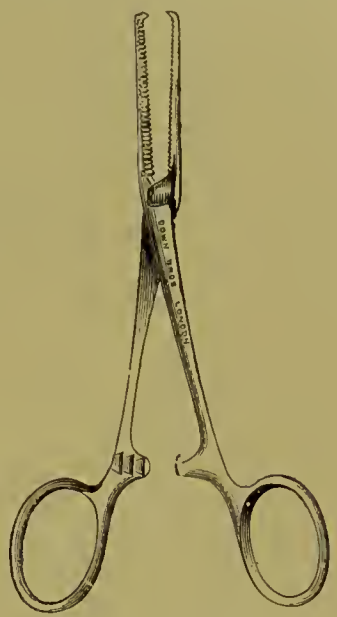


Fig. 87.—Clamp Forceps for the Mesentery in Enterectomy or for the Omentum in Pylorectomy. The blades should not be sheathed with india-rubber.

After the omenta have been divided, the finger works its way in behind the pylorus, and the growth is separated from the structures posteriorly so as to allow the whole mass to be drawn well up into the wound. As this is done, abdominal cloths are packed in around the pylorus in all directions and a small one is passed behind the tumour so as to protect the abdomen in that direction. As the adhesions are divided, the tumour comes right up into the wound until finally the operation can be completed entirely outside the abdomen. While the tumour is being isolated, enlarged glands should be searched for along the greater and lesser curvatures and any found should be carefully shelled out. In doing this, however, great care must be taken not to disturb structures too widely as otherwise serious bleeding may occur, and, more important still, the nutrition of the portion of the organ left behind may be impaired. Any enlarged glands behind the stomach may be left for removal until after the tumour has been taken away.

The next point is to remove the growth. Before doing this the duodenum must be clamped so as to prevent the escape of its contents and

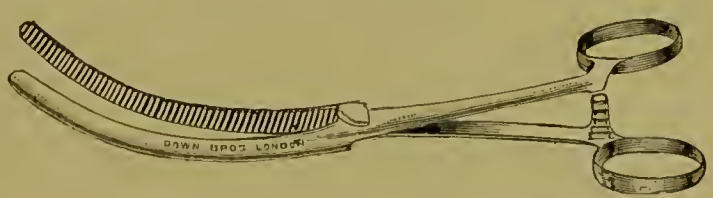


Fig. 88.—Doyen's Pylorectomy Clamp Forceps.

this is best done by a clamp such as Lane's (see Fig. 60) or Makins's (see Fig. 65) introduced well to the distal side of the proposed incision through the duodenum. The occlusion of the stomach on the proximal side of the incision through that organ can be quite safely entrusted to the fingers of an assistant, as it is easy to press the walls of the organ together and to hold it well up if the pylorus has been freed sufficiently. In order to prevent the escape of discharges from the portion of the stomach that is to be excised, it is well to clamp this organ on the opposite side of

the proposed incision both in the duodenum and in the stomach by long compression forceps such as Doyen's (see Fig. 88).

The surgeon now cuts through the stomach wall, directing his assistant to compress the vessels along the greater and lesser curvatures carefully. The line of division through the stomach wall will usually be somewhat oblique. Fig. 89 shows the various modes of section of the



FIG. 89.—VARIOUS METHODS OF PERFORMING PYLORECTOMY. In each case *A* shows the lines of incision for removing the growth, while *B* and *C* indicate the manner in which the continuity of the intestinal canal is restored subsequently.

stomach in different cases, but with reference to some of them it may be remarked that, when the growth is sufficiently extensive to demand their employment, it will in the majority of cases be beyond the scope of a pylorectomy. The simplest plan of dividing the stomach is to cut through both walls together with a knife, performing the section as rapidly as possible and instructing an assistant to throw an abdominal cloth over the divided end of the viscus, and to raise it well up and pull it over to the left-hand side out of the abdomen immediately the section is complete; another assistant at the same time pulls the pylorus and the growth to the opposite side. This latter mass is now covered up in an abdominal cloth and can easily be kept out on the abdomen away from all risk of fouling the peritoneal cavity, whilst the surgeon proceeds to suture the

divided end of the stomach. This can be rapidly done by a continuous suture taking up all the coats of the viscus and shutting off the stomach cavity and at the same time compressing oozing points. Any spurting vessels may be seized and twisted or tied and the assistant can control the bleeding quite readily between his fingers. The occluding suture just described is now buried by invaginating it with a continuous sero-muscular suture of fine silk. This sewing-up of the stomach is precisely similar to that for a simple gastrotomy and has already been described (see p. 212). It is well in these cases, where the line of incision across the stomach is a long one, to divide the continuous sero-muscular suture into at least two or three, so that there is less risk of the wound opening up if one loop of the suture slips or cuts its way out.

When this suture has been completed, all blood is sponged up, the stomach wall is carefully sponged over, wrapped round with a fresh abdominal cloth and allowed to drop back into the abdomen, whilst the surgeon turns his attention to the removal of the tumour and the division of the duodenum. The portion to be removed, enveloped in its abdominal cloth, is well raised by the assistant, the duodenum is pulled forwards, the first part of it is cut across and the whole tumour, together with the clamps upon it, removed. All that now remains to be done is to attach the open end of the duodenum to the remains of the stomach an inch or two behind the line of section in that organ and rather nearer to the greater than the lesser curvature. This attachment, which is strictly a gastro-duodenostomy, is performed by simple suture, the cut end of the duodenum being attached to the margins of the fresh opening into the stomach and is done in a precisely similar manner to gastro-enterostomy where the Y-operation is performed (see p. 256); if speed be an object, Mayo Robson's bobbin may be used. Before actually making the anastomosis, the region behind the pylorus and the stomach must be carefully examined for enlarged glands, which are removed by dissection when found.

The method above described is that which we have successfully used in several cases of pylorectomy and the one that we prefer for various reasons to all the others with which we are acquainted. In the first place it is in our opinion simpler than the method originally recommended, which consisted in closing the upper three-fourths of the line of section in the stomach and then uniting the open end of the duodenum end to end with the lower fourth (see Fig. 89). This has more than one disadvantage; it is undoubtedly difficult to unite satisfactorily by simple suture two portions of intestine having so different a calibre and consistence as the stomach and the duodenum, and there must always be a weak spot where the circular line of anastomosis joins the vertical line of simple suture. We prefer the posterior surface of the stomach for making the anastomosis, because as a rule the duodenum lies considerably deeper than the stomach, although this is not a point of very great importance, and the anterior

surface may be chosen if it be preferred. A glance at Fig. 89 will show the various methods of union that have been adopted.[1]

All that now remains to be done is to remove the clamp from the duodenum, clean up the operation area very carefully, and apply the necessary number of ligatures to the divided edge of the great omentum. The vessels in this structure should be tied separately, if time allows, so as to avoid any large raw surface which might contract troublesome adhesions to important structures during healing.

After-treatment.—This is precisely the same as for gastrotomy and gastro-enterostomy (see p. 217). The shock accompanying the operation is nearly always profound, but is not as grave as might be anticipated from the severity of the operation. It is generally advisable to have recourse to large saline injections either into the rectum, the abdominal cavity, or even into the veins. Infusion into the two former situations should be practised in any case and the intra-venous infusion should be done if the shock be very profound and should be repeated as often as its good effects appear to be passing off. The other precautions against shock (see Part I., p. 139) must also be adopted.

Combined pylorectomy and gastro-jejunostomy.—The method just described is the one that we have always so far found suitable, as the divided ends of the duodenum and stomach usually meet easily. It has however been objected that this method is not always applicable when larger portions of the stomach have to be taken away. Should it happen that at the end of the operation it is impossible to anastomose the duodenum to the stomach, the operation may be satisfactorily completed by invaginating and suturing up the divided end of the duodenum in a manner exactly similar to that previously carried out in the stomach and then, after having thoroughly cleaned up the operation area, and removed any glands behind the stomach, the latter structure with the transverse colon and the omentum should be raised, the jejunum defined and an ordinary posterior gastro-enterostomy performed (see p. 247).

Gastro-enterostomy.—If the surgeon finds, after a thorough examination of the tumour, that it is inadvisable to perform pylorectomy, the best thing is to establish a communication between the stomach and the jejunum in the ordinary manner before closing the abdominal wound; full details of this have already been given (see p. 240). Here the anterior operation will be the one of choice, because the adhesions on the posterior surface of the stomach may be so great as to prevent the proper turning forwards of that organ.

[1] At the meeting of the Clinical Society on November the 8th, 1901, Mr. Moynihan read a paper on this subject which is well worthy of study by anyone proposing to operate on cancer towards the pyloric end of the stomach. He pointed out that in order to remove probably infected lymphatic areas it is necessary to take away a considerable portion of the stomach (see *British Medical Journal*, November 16th, 1901, p. 1470).

Duodenostomy.—The only other method of treatment at all likely to be adopted in these advanced cases of cancer is a permanent duodenostomy. This may be called for when the cancer is too far advanced for excision and when it also spreads so extensively over the surface of the stomach that there is no possibility of performing a gastro-enterostomy successfully. A permanent opening on the further side of the growth is therefore the only means of prolonging the patient's life, but in these cases he is so near death when the operation is performed that the chances of any material prolongation of life are extremely slight, and we have never yet recommended it.

The operation, if decided upon, is done through the ordinary vertical incision slightly to the right of the middle line, and the duodenum if possible is brought up into the wound, fixed in position by sutures and opened two or three days afterwards, much in the same way as for inguinal colotomy. It may be impossible to get the duodenum up to the abdominal wall owing to the extent of the growth, and then the only thing to do is to bring up a loop of the jejunum. The opening in the jejunum must be very small so as not to interfere with the passage of bile and pancreatic secretion past the artificial orifice; it is particularly important not to form a spur, as is done in inguinal colotomy, or the bile and pancreatic secretion will be discharged through the wound to the patient's great discomfort and disadvantage. When the loop of bowel is drawn up into the wound, only enough of it is drawn through the opening to just protrude beyond the skin, and the abdominal wall is sutured to the sero-muscular coat by six or eight interrupted catgut sutures. Two guiding sutures are passed through the intestinal wall opposite the ends of the proposed future incision, and the bowel is left unopened for two or three days, at the end of which time a small opening, sufficient to admit a large catheter, is made into the bowel.

3. Of cancer of the cardiac end of the stomach.—This condition is practically identical with malignant disease of the cardiac end of the œsophagus, at any rate as far as its treatment is concerned, and has already been fully dealt with (see p. 117).

CHAPTER XVI.

INJURIES OF THE INTESTINES, THE OMENTUM AND THE MESENTERY.

Penetrating and non-penetrating wounds of the abdominal wall have already been dealt with (see Chap. XI.) as have also injuries of the stomach (see Chap. XIII.). We shall here deal with the similar affections of the intestine, both large and small, and shall include also injuries of the omentum and the mesentery. The effects of an injury differ according as it is a contusion or an incised wound, and either may produce two very important and distinct results, namely, (*a*) bleeding, and (*b*) injury to the intestinal wall.

Excessive and even fatal hæmorrhage may follow *wounds of the omentum or the mesentery* without any injury to the intestinal wall. The extent of the lesion varies from a simple longitudinal tear which does little more than rupture one vessel to an extensive laceration of the omentum or detachment of the mesentery either from the spine or the bowel; in the latter case very serious secondary intestinal phenomena may result from the injury to the blood-supply of the bowel. Of course there are other possible sources of blood found on opening the abdomen after an injury and naturally these must be sought for and if possible dealt with, but they will be referred to later in connection with the organs concerned.

Serious hæmorrhage may also occur when there is injury to the intestinal wall and the larger arterial trunks as they leave the mesentery to supply the intestine; here there is a combination of severe internal hæmorrhage with perforation of the bowel.

An injury to the abdominal wall may cause partial or entire *rupture of any portion of the intestinal canal.* The parts most frequently affected are the jejunum and, with nearly the same frequency, the ileum; but in severe crushes, such as occur when the abdomen is run over by a heavy cart, the more fixed portions of the intestine, such as the duodenum, the cæcum and the ascending colon, suffer most. The injury to the bowel may vary from a simple contusion to an extensive laceration or a complete division of the

intestine; the injuries may be limited to one coil of bowel or they may be multiple. As a rule they are more likely to be multiple in cases of penetrating wounds than in contusions, but in treatment it is always well to remember the possibility of multiplicity and to satisfy oneself that all the injuries have been seen to.

The injury is met with most frequently on the convex surface of the intestine; in bad contusions a portion of the bowel may be torn asunder, usually a movable from a more fixed portion, such as the jejunum from the duodenum or the ileum from the cæcum. The transverse colon is perhaps the part of the large intestine most frequently injured; after that the cæcum and then the descending colon.

When perforation occurs in any part of the small intestine except the duodenum, the contents of the bowel pass directly into the general peritoneal cavity; the second and third parts of the duodenum however are not entirely surrounded by peritoneum and a rupture on the posterior surface there will be followed by extravasation into the cellular tissue behind, and this will lead subsequently to an abscess which points in the perinephric, iliac, or sub-diaphragmatic regions. These wounds of the duodenum with infection of the cellular tissue behind are very fatal; as a rule the patient dies of septic poisoning and it is rarely possible to do anything effectual in the way of treatment. The same is true of wounds affecting only the posterior surface of the ascending or descending colon.

Differential diagnosis between hæmorrhage and ruptured bowel.—The first and most important point in these intestinal cases, as distinguished from the gastric ones, is to try to distinguish hæmorrhage into the abdomen from rupture of the intestinal wall. The reason that this is so important is that in the case of hæmorrhage the sooner the operation is performed the better is the chance for the patient, whereas in an intestinal rupture it is well to wait for some recovery from the shock. Unless the patient recovers from the profound shock accompanying the rupture, he is very likely to die of the laparotomy; in most cases some amount of reaction will set in. In the case of hæmorrhage, however, waiting for recovery from shock would merely allow the bleeding to go on until operation would be useless. At first, no doubt, it is very difficult to say whether a patient is the subject of internal hæmorrhage or of perforation; in both cases he is blanched and suffering from severe depression.

If the case be one of hæmorrhage there will be all the general symptoms already described (see Part I., p. 135), while at the same time there is often localised dulness over the front of the abdomen, or dulness appears in the more dependent parts such as the flanks or the pelvis, where the finger in the rectum or the vagina may detect the presence of an accumulation of fluid in Douglas's pouch. These symptoms would not be met with for some time were the case one of ruptured bowel, as the amount of the intestinal contents escaping is not sufficient to produce any marked swelling or dulness; on the contrary there is more likely to be a tympanitic condition from distension

with gas. In rupture of the intestines the dulness and swelling do not supervene until later when peritonitis has set in. Hence marked collapse with extreme pallor and the general signs of hæmorrhage accompanied by dulness in the dependent parts of the abdomen indicate hæmorrhage and call for immediate operation.

In rupture of the intestine, as distinguished from hæmorrhage, the patient suffers early from profound shock which it is by no means easy to differentiate from that due to the injury to the abdomen as a whole. The symptoms so closely resemble those of similar conditions in the stomach that, as these latter have already been described (see p. 206), we need not go at all fully into the symptomatology. With the exception of hæmatemesis, which is not present in the cases of which we are now speaking, the symptoms are practically identical. In intestinal injuries, however, the abdominal distension from gas free in the peritoneal cavity is generally much more marked. When there is much shock it is well to wait for a short time before deciding to open the abdomen except in penetrating wounds, when operation is always required; even here however it is well to wait an hour or so and to employ meanwhile suitable measures for the relief of the shock.

TREATMENT OF INTERNAL HÆMORRHAGE.

The methods both of opening and of closing the abdomen have been fully discussed (see p. 188). The incision should be free, as it is essential to make sure by thorough inspection of the abdominal contents whether injury has occurred; it should be vertical and at least six inches long, and may require enlargement subsequently. The most convenient plan is to make the umbilicus the mid-point of the incision. If the opening be entirely below the umbilicus it must be extended upwards in order to examine the attachment of the mesentery, and certainly the omentum cannot be got at through such an incision; whereas, if the umbilicus be its centre, all parts of the abdomen are accessible and it is quite easy to enlarge it either upwards or downwards.

The details of the procedure immediately after opening the abdominal cavity for any serious injury to its contents has already been gone into so fully that it is needless to recapitulate them here; the reader is referred to p. 178. The object is to ascertain with the minimum amount of disturbance to the parts whether there is a perforation of the bowel or serious internal hæmorrhage and whether the latter proceeds from one of the large viscera, such as the liver or spleen, or whether it is superficial or deep to the omentum. We shall first assume that an injury of the omentum has been found.

INJURY TO THE OMENTUM.—The first thing is to rapidly turn out the omentum upon a hot abdominal cloth and to inspect it. This structure may be torn either vertically or transversely; in the latter case the hæmorrhage is much more severe than in the former and occasionally

the greater part of the membrane is torn from the stomach. Sometimes the blood, instead of escaping into the peritoneal cavity, infiltrates the substance of the omentum and gives rise to a large, localised hæmatoma.

When the omentum is wounded towards its upper part, the abdominal incision should be at once extended upwards so that the entire structure can be examined without any traction; for it is extremely delicate and traction may easily increase the rent or rupture some large vessel and thus add seriously to the bleeding. The best way to extend the incision upwards is to slit up the whole thickness of the abdominal wall at once with strong scissors or a probe-pointed bistoury, clamping bleeding points as they are met with.

In dealing with bleeding, two points must be borne in mind, namely, the arrest of the hæmorrhage and the avoidance of any hole in the omentum through which strangulation might occur or any loose strand which might form a band and so favour intestinal obstruction.

A simple vertical rent in the omentum can be sewn up accurately with a curved needle and fine catgut after the vessels have been picked up and tied on the surface of the tear. It requires some skill in doing this to avoid perforating other vessels in the vicinity which might give rise to troublesome bleeding. Should this accident take place, the wounded vessel had better be under-run with fine catgut on a fully-curved Hagedorn needle.

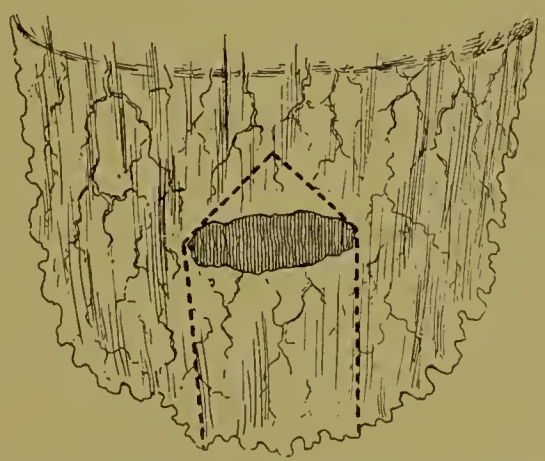


FIG. 90.—METHOD OF TREATING AN HORIZONTAL RENT IN THE OMENTUM. The shaded area represents the gap made by the laceration; the dotted lines are the lines of section of the omentum (after ligature of the vessels) in order to make a gap that can be easily sutured.

When there is a transverse rent of the omentum, the procedure will depend upon its extent. Small rents can be stitched up after the vessels are tied; if they be more extensive it will probably be best after tying the vessels to take out a wedge of the omentum (see Fig. 90) and then to stitch the edges accurately together throughout.

When there is a large hæmatoma in the omentum it is very difficult to find the bleeding point and, as the large mass will ultimately lead to widespread adhesions, it is better to excise it completely. This is done by inserting a

series of interlocking ligatures around the hæmatoma (see Fig. 91); the hæmatoma is then excised and the cut surfaces stitched together with fine catgut. This is quite easy if the sutures be arranged in a large semi-circle.



FIG. 91.—REMOVAL OF A HÆMATOMA FROM THE OMENTUM. A very long thread is taken and the omentum transfixed all around the hæmatoma as depicted above. A series of loops is made and these are divided along the marks shown in the diagram so as to produce a number of separate ligatures which are tied one by one. As the needle is made to transfix the omentum the thread each time is caught by a hook or by forceps, the needle withdrawn still threaded and made to transfix the omentum again further on, where the same procedure is repeated. The gap shown in the right-hand sketch is closed by a few points of suture between the opposite sides. Before tying, each thread is twisted round the adjacent one of the suture following, so as to interlock.

INJURY TO THE MESENTERY OR THE MESO-COLON.—Should it be found on opening the abdomen that the omentum is uninjured but that there is free hæmorrhage, the best thing is to turn out the omentum and transverse colon on to an abdominal cloth spread upon the chest and to slip the hand rapidly down along the under surface of the transverse meso-colon as far as the spine, where the aorta will at once be felt and may be compressed together with the root of the mesentery, so as to temporarily arrest the hæmorrhage, whilst the actual bleeding spot is being searched for. This method of temporarily arresting the bleeding should then be entrusted to an assistant, so as to leave the surgeon's hands free. The search for the bleeding point is best carried out by rapidly turning out the intestines, swabbing away blood or clot from the coils as rapidly as possible and then returning coil after coil into the abdomen until the seat of hæmorrhage is found. The best plan is to begin at the lower end of the ileum at its junction with the cæcum and to examine and put back the coils of small intestine from that point.

When found, the bleeding point may be temporarily compressed whilst the wound is enlarged or the intestines are arranged so as to have the parts completely in view. The further procedure will depend upon the nature of the injury; when this is *a mere slit*, the bleeding point can usually be seized in forceps, a ligature applied and the slit stitched up with fine catgut, taking care not to puncture the vessels with the needle.

Much more serious however is *a transverse tear of the mesentery* which is generally met with close to the intestine; should it occur at the root of the mesentery the patient will probably bleed to death before surgical assistance can be obtained. The importance of these cases is due not only to the free bleeding to which they give rise but to the serious damage to the blood-supply of the corresponding segment of the intestine; except when the tear is quite small the portion of intestine involved is completely deprived of its blood-supply and will subsequently become gangrenous. It is uncertain how much of the mesentery may be thus detached without causing gangrene, but it is not very much; if it be detached for two inches or more, gangrene is practically certain to occur and it is absolutely necessary to remove the affected portion of the bowel in order to avoid it. When the rent is less than an inch long, it may be sufficient to tie the bleeding points and re-attach the mesentery to the intestine, but in the more extensive cases, and certainly in all those in which two inches or more are torn away, the loop of bowel involved should be excised and the ends united by an end-to-end anastomosis (see p. 306). This question of interference with the intestinal blood-supply must be considered even in vertical rents, because the bleeding vessel may supply a considerable section of the intestine and its ligature may lead to gangrene in that portion just as if the mesentery had been torn from the bowel; it may happen therefore that a certain amount of the intestine will have to be excised here also.

When the injury is deep down at the root of the mesentery it is extremely difficult to tie the bleeding points, and attempts to do this sometimes lead to further laceration of the vessels, as the forceps tear through or the mesentery gets more damaged through the manipulations. When there is much trouble of this kind the simplest plan is to leave on the forceps which secure the bleeding point. The handles of the forceps are left protruding through the abdominal wound, which is stitched up completely except at this point; here temporary stitches are inserted to be tied when the forceps are taken off at the end of about 48 hours. At the end of that time the forceps are gently unlocked and withdrawn from the wound, the temporary stitch is tied and the wound is thus completely closed.

When the bleeding has been arrested it is well to flush out the abdomen with hot normal saline solution (see p. 177). This is done partly to remove clots which, if left behind, organise and may give rise to troublesome adhesions subsequently, and partly to fill the blood-vessels with fluid. If necessary, a saline intra-venous injection must be employed. The abdominal wound can as a rule be closed without any drainage; when however it is not quite certain that the oozing has completely stopped it may be well to introduce a Keith's glass drainage tube into Douglas's pouch with a narrow strip of gauze in its lumen so as to act as a capillary drain. This should not be left in for more than 24 hours.

TREATMENT OF RECENT INJURIES TO THE INTESTINAL WALL.

Early operation is so vital in severe injuries to the intestinal wall that the surgeon should always go to the case fully prepared to operate and should remain with the patient until he has made up his mind on the question. To go and see a patient, to find him profoundly collapsed and then to return some hours later to see how he progresses is merely to jeopardise his life. The surgeon should have everything prepared for operation even before he makes up his mind, and should then watch the symptoms carefully, so as to be able to intervene at the earliest possible moment that is safe.

The prognosis of intestinal rupture is very grave, the average duration of life from the time of the accident being about 48 hours and, if the patient is to have a really good chance, the operation must be done within three or at the most six hours from the receipt of injury; after that the chances of eradicating sepsis are very slight and attempts to do so by extensive manipulation of the inflamed intestines and peritoneum give rise to the most profound shock, of which the patient dies. Hence we should say that, unless the operation be performed during the first few hours (certainly within the first 24), it is better to leave the patient alone and to give him the chance of the inflammation becoming localised and followed by the formation of an abscess, than to make any attempt to cleanse the general peritoneal cavity.

In the interval during which the surgeon is waiting to make up his mind as to operation, appropriate measures should be taken against shock (see Part I., p. 139), particularly the free employment of stimulants combined with rectal or subcutaneous injections of hot salt solution. Directly it is decided to operate, it is well to administer a full dose of morphine, as the shock is often much diminished by the relief of pain it affords; the pulse improves at the same time and the fæcal extravasation diminishes because the intestine is quieted. Morphine should however never be given earlier than this, because the improvement following it is sometimes so marked that the surgeon is apt to leave the patient alone and so to allow him to die of peritonitis. During this period also all the preparations for the operation should be made and the skin shaved and disinfected, so as to reduce to a minimum the time that the patient has to be under the anæsthetic. These points will be found fully dealt with in connection with the injuries to the abdomen (see p. 177).

We have already pointed out that, unless there be a very strong indication as to the seat of the injury in the bowel, the abdominal incision should be made close to the middle line. No doubt the ruptured intestine often remains motionless beneath the badly-bruised abdominal wall and the more fixed portions of the bowel, such as the cæcum, cannot of course move out of the way; these cases may possibly form exceptions to the general rule, but in the great majority, even of punctured wounds, opening the abdomen in the middle line will be the best practice. The actual seat of rupture may be

to some extent diagnosed as soon as the abdomen is opened by the nature of the intestinal contents extravasated (see p. 179). It has already been recommended (see p. 179) that, when neither blood or fæces appear on opening the abdomen, it is well to pass the small intestine in review from the cæcum upwards and, if nothing be found in them, to inspect the large bowel. This is done to ascertain whether there be any rent in the peritoneal coat or even a puncture which is temporarily plugged by prolapse of the mucous membrane. When the rent is at all extensive, intestinal contents, either alone or mixed with blood, will almost certainly appear immediately on opening the abdomen or, if not then, on lifting up the omentum and pressing back the intestinal coils.

NON-PENETRATING WOUNDS.—It is important, even in rents of the serous or muscular coats alone, to approximate the edges, because bacteria may pass through the wound and lead to peritoneal infection; adhesion to other coils may also occur and give rise to trouble subsequently.

When the mucous membrane is not perforated it suffices to approximate the edges of the rent in the serous coat by a fine, continuous catgut suture introduced on Lembert's plan (see p. 213), so as to tuck in the free edge of the wound and to give a more perfect adhesion. As the intestinal cavity is not opened a single continuous suture will suffice.

When there is either a tiny puncture into the lumen of the bowel or when, as sometimes happens, there is a perforation at the end of a longish split of the serous and muscular coats, the mucous membrane must be tucked in and a double row of Lembert's stitches applied. It is not necessary to suture first the mucous and then the sero-muscular coats, unless there be a widely gaping wound; a double row of Lembert's stitches will suffice. There is practically no soiling of the peritoneal cavity in these cases so that nothing is required beyond gently mopping the bowel at the point of injury after the stitches are put in.

PENETRATING WOUNDS.—Much more serious are the cases accompanied by fæcal extravasation and in them practically the only thing that gives the patient a chance is thorough cleansing of the abdominal cavity followed by permanent closure of the wound in the intestine.

(a) **In the small intestine.**—The remarks made regarding injuries of the stomach (see p. 209) will apply to injuries of the first part of the duodenum, so that we need not deal with them here. In some cases the injury to the small intestine is at once evident on opening the abdomen and it is clear also that the fæcal extravasation is limited to the peritoneum in its immediate neighbourhood.

Cleansing the peritoneum.—When the injured loop is found it is compressed by an assistant, pulled out of the peritoneal cavity and packed off with hot abdominal cloths (see p. 177) until the abdomen is cleansed, when the bowel injury is repaired. These are the simpler cases and in them careful mopping up of the extravasated intestinal contents and thorough irrigation of the vicinity with hot normal saline solution (see p. 177) will

suffice to cleanse the abdomen; if there be any doubt as to infection of the peritoneal cavity elsewhere, a long glass irrigating tube may be thrust into the abdomen in various directions so as to flush away any material that may be lodged there, but this should not be done until the area in the immediate neighbourhood of the perforation has been most carefully cleansed. The injury to the bowel is then permanently closed in the manner described on p. 305.

The most serious cases however are those in which the extravasation has extensively soiled the peritoneal cavity and in which the injured coil of intestine does not show at once but lies deep down or has moved away from its original position, necessitating a search among the coils for the seat of the injury. Even graver still are the cases of commencing peritonitis, because the distended intestines are not easily handled, the manipulation increases the shock and the infection has got a firmer hold.

Evisceration.—In these graver cases with extensive fæcal extravasation and where the affected coil is not immediately evident, there is a choice between two methods of procedure: either to gradually separate the coils until the injury is found and then to wash out the fæcal matter by introducing irrigating tubes into various parts of the abdomen, or to extend the incision in the abdominal wall boldly upwards and at once to eviscerate the patient. It is quite clear that the latter method is the only one that offers the patient a suitable chance in these grave cases. Manipulation of the intestine, especially when it is inflamed, simply means increasing the shock, prolonging the operation indefinitely, imperfectly cleansing the abdominal cavity and increasing the extravasation from the seat of injury during the manipulations. The fact that there have been a few recoveries under these circumstances does not invalidate this statement. In the evisceration method all the intestines are at once turned out of the abdominal cavity and any further fæcal extravasation must take place outside it, while the injured coil is immediately exposed to view and much time is saved. Large, hot abdominal cloths must be at hand for the reception of the intestines and these should only be very lightly wrung out of salt solution as, if they be at all dry, they tend to stick to the coils. The intestines can be turned out in a moment if the incision be sufficiently large and the edges held well aside. They should be rapidly douched with hot normal saline solution (105° F.) so as to wash away any fæcal material on the surface, and are then enclosed in the abdominal cloths.

Before proceeding further with the treatment of the intestine, the surgeon turns his attention to ridding the peritoneal cavity of the extravasation, and this can be done very rapidly directly the coils of intestine are outside the abdomen. A strong stream of hot, normal saline solution is directed into the peritoneal cavity, the edges of the incision in the abdominal wall being held apart so as to allow the fluid to escape freely; the whole abdomen is filled up and the solution is allowed to overflow freely, using many pints in the process. When the extravasated material has apparently been thoroughly

removed, it is well to mop up the fluid and so to remove any particles still swimming in it; for this purpose it is best to employ pads of sterilised wool, which should not be used a second time. Special attention should be paid to Douglas's pouch and the lumbar regions.

The peritoneal cavity is finally filled up again with the hot saline solution, a cloth is thrown over the abdominal incision and the eviscerated coils are examined. During the examination it is well to keep a stream of hot saline solution flowing over the intestines so as to wash away any fæcal material; to avoid the risk of this passing into the abdomen the patient should be turned slightly upon the left side. Commencing at the lower end of the ileum, the intestinal coils are rapidly and methodically passed under review and irrigated, and the uninjured bowel is slipped back coil by coil into the abdomen until the damaged portion is found. This is at once wrapped up carefully in a separate abdominal cloth of suitable size and given to the assistant, who grasps the whole of the damaged coil in his hand so as to prevent further extravasation, and holds it well out of the way. The mesentery and the intestinal coils in its immediate neighbourhood are next thoroughly irrigated and the rest of the intestinal loops are rapidly passed under review, irrigated and returned into the abdomen if uninjured. Should a second injury be found the affected coil is similarly isolated. In this way the intestines can be thoroughly cleansed and the sound coils replaced in the abdomen whilst the damaged bowel is shut off and further extravasation prevented.

As soon as all the sound coils have been returned into the abdomen, fresh hot abdominal cloths are packed over them so as to still further shut off the damaged portion. The above procedure takes some time to describe and sounds rather formidable, but it can be done with the greatest rapidity, and a moment's reflection will show that it is by far the most satisfactory way of dealing with those extremely grave injuries.

A clamp, such as Lane's (see Fig. 60), is then applied to the bowel on each side of the injury and the portion between is thoroughly emptied by squeezing and irrigation. The whole loop is cleansed thoroughly while the surgeon decides how to treat it.

Treatment of the injured bowel.—This will vary with the seat and extent of the lesion. In the cases of which we are speaking, the edges of the rent are almost always irregular or contused and are very likely to slough, or at any rate to become the seat of development of bacteria such as the colon bacillus, so that the stitches fail to hold and septic peritonitis with possibly perforation may follow. It will be necessary therefore in all these cases to remove the contused edges so as to give a clean-cut surface for union; should the rent be very extensive, this may entail so much narrowing of the lumen of the bowel when the incision is sutured that it may be preferable to excise the damaged portion and to make an end-to-end anastomosis. This is particularly the case when the rent extends through the mesenteric border of the intestine, the suture of which is by no means an easy matter. Hence, we recommend that the rent in the intestine should only be sutured when it is

comparatively small, and is so situated that, after paring its edges, there will be no constriction of the bowel on suturing. It must always be remembered that the lumen of the bowel may be actually increased by converting a comparatively short longitudinal rent into a transverse one by bringing the extremities of the wound together as is done in pyloroplasty or gastroplasty (see p. 238). This however will not be feasible if the rent be a long one. When the intestine is actually torn across from one border to the other, an end-to-end anastomosis must of course be established and before doing this it is well that the torn edges should be freely cut away so as to insure the approximation of healthy surfaces. We shall now describe the methods by which the intestine may best be united.

Methods of uniting divided intestine.—These fall into two large classes: 1. End-to-end suture of the divided portions without the employment of any mechanical apparatus; and 2. Anastomosis effected with various mechanical aids. The latter class may again be subdivided into those methods in which the artificial aids are employed more with the view of insuring accuracy of coaptation than of shortening the length of the operation, whilst in the other the chief aim is to diminish the time employed in the operation. We have thus three main groups to consider:—(*a*) Simple suture; (*b*) Union aided by apparatus which renders the suturing more accurate and perhaps more rapid; and (*c*) Union by means of apparatus designed mainly to shorten the operation.

A great number of ingenious methods have been introduced for accomplishing these various ends, which it would only confuse the reader to describe in detail; they will be found in various text-books, and we would especially refer the surgeon to Jacobson's *Operations of Surgery* where a considerable number of the more important are fully described. As a matter of fact a number of these are equally good, and each surgeon will soon come to adopt at the most two or three to which he becomes most accustomed, and we are inclined to think that success in these cases depends more upon doing well the operation to which one is accustomed than upon the actual method itself. The various operations can be very readily practised, seeing that portions of animals' intestines can be obtained at any time for their experimental trial. We should recommend every surgeon who is at all likely to be called to cases of this kind to repeatedly try the various plans and ascertain for himself which he is most likely to execute rapidly and easily, and then to practise these particular forms to the exclusion of others. Cases requiring intestinal suture do not occur every day, and it is impossible for anyone to carry in his head all the different modifications that have been proposed.

After having tried all the principal methods we have practically come to rely upon three of them as suited to all the cases likely to be met with in practice. These are simple suture, suture with the aid of Mayo Robson's bobbins, and the employment of Murphy's button.

(*a*) *End-to-end suture.*—There are a number of methods of performing

end-to-end suture of the intestine, some of which only differ slightly in the manner in which the intestine is cut, whilst some, such as Maunsell's method, differ in the manner in which the suturing is done. We have repeatedly tried Maunsell's method, which will be found described in various books, but we find that we can perform end-to-end anastomosis much more conveniently by the ordinary plan.

In recent wounds of the intestine the procedure is as follows: The injured coil to be excised is emptied of its contents and shut off by an intestine clamp, such as Lane's (see Fig. 60) arranged on each side at a suitable distance from the proposed point of section; in order to get sufficient room to work in properly this should be at least 3 inches. The bowel is then cut across with a large pair of scissors and the damaged portion is removed by cutting along its mesenteric attachment. The line of section

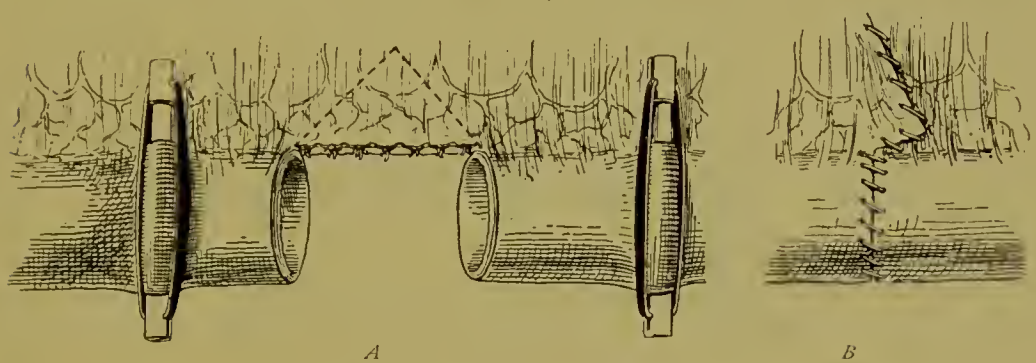


FIG. 92.—TREATMENT OF THE MESENTERY IN ENTERECTOMY. The diagram shows how the bowel is separated from the mesentery in cases of injury. The dotted lines indicate the V-shaped portion that must be removed in enterectomy done for strangulation. The smaller sketch shows how the mesentery is sutured after end-to-end anastomosis in traumatic cases.

of the intestine will generally be transverse; there does not appear to us to be any advantage in making an oblique section in these cases. It is not necessary to remove a V-shaped portion of the mesentery, as there is no thrombosis of its vessels, and this has the advantage that there is no risk whatever of injuring the blood-supply of the remaining intestine; Fig. 92 shows how the redundant mesentery should be treated. In these cases a large loop of intestine never requires removal, and therefore there is no thick bunch of mesentery which it is not easy to stitch together afterwards; this plan is also rather speedier than that of removing a wedge. The latter plan will be dealt with in connection with gangrene of the bowel (see p. 326). It is quite easy to pick up and tie the individual vessels, as the bowel is detached from the mesentery. The divided ends of the gut are well washed out and a narrow strip of the mucous membrane, which prolapses somewhat whilst the muscular coat retracts, may be clipped away from each of the divided ends to save trouble in suturing.

The next step is to unite the divided ends, for choice by *simple suture*, and this is done by a continuous stitch of stout catgut taking up all the coats of the intestine. It begins near the mesenteric border and before

it is inserted the greatest care must be taken to see that the two segments of the intestine are in proper relative position; in order to make sure of this it is well to insert a temporary loop of silk through all the coats of the intestine, one at the convex border of the bowel and a second at the mesenteric attachment. These are given to an assistant to hold and they insure accurate coaptation of the two portions of the intestine and can be removed when the suturing is complete (see Fig. 93). The suture should be carried right round the gut, but should be interrupted in two or three places in order to avoid the risk of puckering up the stitch and so unduly

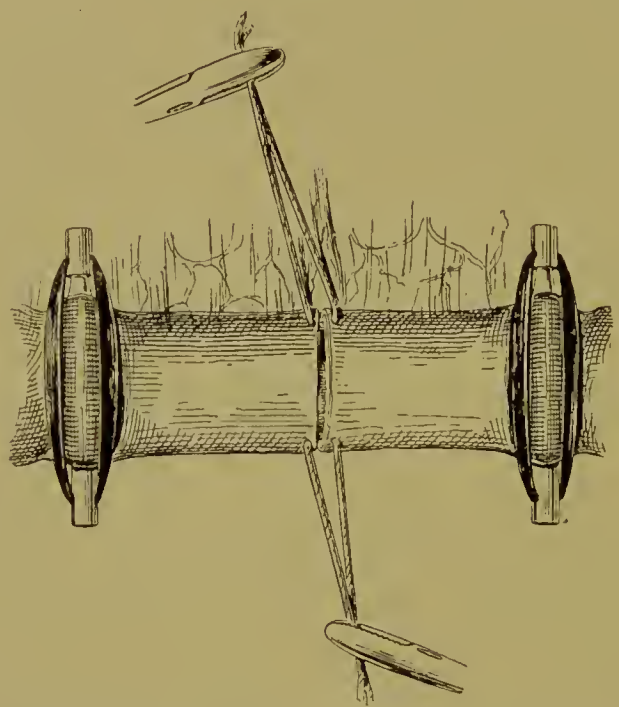


FIG. 93.—METHOD OF ENSURING PROPER APPOSITION OF THE CUT ENDS OF THE BOWEL IN ENTERECTOMY. A guiding stitch is passed, one through the mesenteric and one through the convex border of the bowel, as shown in the figure, and these are given to an assistant to hold while the suture of the ends is effected, after which they are removed.

diminishing the calibre of the bowel. We are accustomed to divide a suture of this kind into three sections in its passage around the intestine instead of having it in one long continuous stitch. Especial care must be taken opposite the mesenteric attachment to see that the suture takes in the muscular coat, which is apt to retract freely in this situation. The suture may be inserted either with a curved or a straight needle as the operation will be outside the abdomen.

When this suture has been inserted, accurate coaptation of the cut surfaces should be assured and the intestinal canal shut off. A continuous Lembert suture of fine silk is now applied outside the first and it is well to interrupt this in two or three places as in the case of the deeper one; it is also very essential to see that, while the stitch is not puckered, it is not unduly lax. Special attention must also be paid to the proper coaptation at

the mesenteric border, and, when this has been done, the aperture in the mesentery should be closed. This may be done in any manner that is found most suitable. When the mesenteric border has been merely detached from the intestine, the projecting mass of mesentery which forms when the ends are brought together must be bent over and sewn together by one or two stitches so as to make the result as sightly as possible (see Fig. 92). This completes the anastomosis; all that remains to be done is to remove the clamps, to clean up the area of the operation thoroughly and to drop back the anastomosed loop into the abdominal cavity, which is closed in the usual manner.

Some surgeons have strongly advocated the use of *omental grafts*, which may be made in two ways; in one method a narrow strip of the omentum is detached between two vertical incisions but left attached at its base, and this is wrapped around the line of union and sutured to the mesentery in front and behind so as to prevent leakage. This plan however is very likely both to interfere with the free movement of the intestine and to form a band beneath which intestinal obstruction may occur. If omental grafts are to be employed at all it is best to use the second method, in which a strip of the omentum is cut completely away, wrapped around the anastomosis and fastened in place by a few fine stitches. The grafts adhere firmly in their new position. In the majority of cases there seems to be no obvious reason for employing these grafts whilst their use certainly increases the length of the operation and may possibly cause subsequent trouble from adhesions. There are some cases however in which a surgeon may feel more confidence when he employs them; for instance when a large portion of bowel has been removed and there is a certain amount of tension on the stitches, or when it is impossible to be sure that the bowel wall at the seat of union is absolutely healthy, the omental graft undoubtedly gives an extra protection.

Mayo Robson's bobbin may be taken as the type of the methods which aim at making the anastomosis more rapid and more exact. There are several other methods upon similar lines, such as Halsted's india-rubber bag, Laplace's forceps, etc., but in our own practice we limit ourselves to the employment of the bobbin, which has the great advantage that it is possible by it to insure the suture being drawn tight enough to make an absolutely water-tight anastomosis, while at the same time it is impossible to cause puckering of the lumen of the bowel, and in this way the operation is undoubtedly shortened. The method of using the bobbin has already been referred to in connection with gastro-enterostomy (see p. 259). In employing it for end-to-end anastomosis in the small intestine the operation is still further expedited, because it is not necessary to begin in the first instance by introducing the outer sero-muscular Lembert suture before bringing together the cut edges on the two sides because here it is easy to get free access to the entire circumference of the intestine. The deeper suture of stout catgut is first introduced through all the coats of the bowel and should be made to traverse about the posterior half of the circumference of the gut before

the bobbin is introduced. The latter is now placed in position, the intestine drawn well in position over it and held there by the finger and thumb of the assistant placed over the open ends of the bobbin (see Fig. 76) and the continuous suture carried around the remainder of the circumference. The two ends of this suture are then drawn tight and tied. By pushing the two ends of the intestine together over the bobbin it is quite easy to insert a second continuous Lembert suture of fine silk outside the first so as to completely bury it. Particular care must also be taken here to see that the muscular coat is properly sutured at the mesenteric border. The circulation of intestinal contents through the bobbin is unhindered owing to the large size of its lumen; the bobbin itself very soon softens and in the course of a few hours becomes partially digested and passes onwards.

Halsted's method is to introduce an elongated india-rubber bag and to inflate this so as to form a support whilst the stitches are inserted; when the suture is almost complete the bag is deflated and pulled out through the line of incision and the union then completed. The bag is not nearly so rigid as the bone bobbin and is apt to be punctured during suture; there is the additional disadvantage of having to pull it out before the union is completed. Laplace's intestinal forceps are open to the latter objection and we must confess that we do not think they bear comparison with the bobbin.

Murphy's button may be taken as the type of the third group of methods in which rapidity of operation is the main point. There is no question but that end-to-end anastomosis can be done much more rapidly by its means than by any other, and therefore we still employ it in cases in which the patient is practically *in extremis*. Its great disadvantage is that the lumen of the vessel is distinctly narrowed at the point of union, whilst the button itself sometimes gives rise to trouble, as it may cause ulceration in its passage through the intestine; the line of union has also been known to give way after the button has become loose. Nevertheless the advantages of the button in desperate cases are very great and it is always possible to perform a second operation at a later date and under more favourable circumstances should symptoms arise indicating considerable narrowing of the lumen of the bowel. A point of great practical importance in using these buttons is to see that the two segments of the bowel are not rotated upon their long axes with regard to each other, that is to say, that the mesenteric attachment on the one side corresponds to that on the other. This accident has happened more than once in the hurry of bringing the two halves of the button together, and it must be remembered that when once the two halves have been interlocked they cannot be removed without excising the portion of intestine in which they lie. Fig. 94 shows how the button is fastened into the open end of the bowel.

Lateral anastomosis.—The method of end-to-end anastomosis is practically the only one which is ever called for except when the damaged portion of the bowel is about the ileo-cæcal valve and when therefore the calibre of the two portions that are to be anastomosed differs considerably.

Under these circumstances it may be advisable to invaginate and close the divided ends of the two portions and then to perform a lateral anastomosis in the manner already described for gastro-enterostomy (see p. 249). This method, which is very valuable for the union of two portions of bowel of unequal calibre, will be referred to again in connection with intestinal obstruction (see Chap. XVII). In wounds of the intestine however, where the two ends are of the same calibre, lateral anastomosis of this kind would be mere waste of time and would not give a superior result.



FIG. 94.—MURPHY'S BUTTON IN ENTERECTOMY. The sketch shows how the running suture is inserted in the open end of the bowel, which is puckered up around the stem of the button when tied.

The question of the formation of an artificial anus or a fæcal fistula, which often arises in cases of intestinal obstruction will hardly ever arise in cases of wounded intestine. In them the bowel is perfectly healthy on both sides of the injury and an end-to-end anastomosis by one of the methods we have already described is as rapidly made as is an artificial anus.

(b) In the large intestine.—The above remarks concerning wounds of the small intestine apply also to those of the large. In the latter however the treatment is in some respects simpler, whilst in others it is more difficult. On the one hand, the damage to the bowel rarely extends to complete division, and, moreover, the size of the colon enables even large wounds to be sewn up without material interference with its lumen. On the other hand, the anatomical arrangement of the peritoneum in connection with the colon makes it hard to get proper access to the bowel and renders the manipulations necessary for the suture of large rents or complete divisions of the gut a matter of the greatest difficulty. This applies with special force to the ascending and descending colon, where all the procedures have to be carried out deep down in the abdominal cavity and the intestine cannot be drawn up from the flanks so as to enable its posterior aspect to be got at satisfactorily. It will probably

be necessary, at any rate in cases where the rupture of the colon is complete, to make the incision in the abdominal wall directly over the bowel in order to get proper access to it. If the abdomen has been opened by the usual median incision in order to discover the lesion, this will necessitate a second opening.

The steps for the union of the divided bowel will be the same as in the case of the small intestine except that in performing end-to-end anastomosis the external or sero-muscular suture must be inserted along the posterior aspect of the bowel before the inner continuous suture uniting all the coats is commenced; in other words, the method of suture is precisely similar to that employed for gastro-enterostomy (see p. 249).

After-treatment.—After the clamps have been removed, the area of operation cleaned up and the united loop of intestine dropped back into the abdomen, the latter is flushed out once more with hot saline solution (a quantity of which is left behind to be absorbed) and the abdominal incision is sutured. The question of drainage in these cases is precisely on a par with that in rupture of the stomach (see p. 215). Should there be any reason to doubt the vitality of the line of union, a small gauze drain may be introduced down to the portion of intestine operated upon, so that, should the anastomosis give way, a fæcal fistula will result instead of extravasation into the abdominal cavity. This is really the only circumstance under which drainage should be employed, as any attempt to drain the whole abdominal cavity when the irrigation of the abdomen has not sufficed is futile. If drainage be employed, and it should be dispensed with wherever possible, the peritoneum should be sewn up closely around the drain, as otherwise vomiting after the operation may drive a coil of the small intestine through the opening into the layers of the abdominal wall, where it may become strangulated; this accident has happened more than once.

The treatment immediately after the operation will be mainly directed against shock and will be similar to that described for cases of perforating wounds of the stomach (see p. 217). The after-treatment will also be largely on the same lines, the principal point of difference being the question of feeding. When the small intestine has been united at or below its middle, there is no reason for not feeding by the mouth, provided that the food be fluid and easily digestible. The main point is to avoid undue movement of the intestines and particularly distension, which would endanger union by causing the stitches to cut through. The food should be entirely liquid and should consist either of fluid meat preparations, or peptonised milk. Should there be any tendency to flatulence, rectal feeding (see p. 234) should be combined with feeding by the mouth.

The union of the intestinal wall will generally be complete in from five days to a week; should perforation occur, it usually sets in about the fourth day and it is generally quite safe to attempt to obtain an action of the bowels at any time after that period. The patient should have an

enema daily and, if anything further be required, some saline mineral water may be administered; no violent purgatives should be allowed. Unless there be much pain it is well to avoid the use of opium after the operation as it is advisable not to paralyse the intestine. Morphine injections are, however, frequently called for in the early stages on account of pain, but they should not be persisted with after they can be dispensed with.

TREATMENT OF INJURIES TO THE INTESTINE OF LONG-STANDING.

The cases we have spoken of above are those seen immediately after or within a very few hours of the accident. It not infrequently happens, especially in gunshot wounds in the field, that the case is not seen until a long time has elapsed, and then the nature of the case is essentially different and it becomes practically a septic peritonitis of the very worst type. When once general peritonitis has become established, there is no object whatever in operating in the great majority of cases, as there is practically no hope of cleansing the abdominal cavity and thus arresting the septic peritonitis, whilst the mere operation, involving as it does a great amount of shock from the handling of inflamed intestines, will probably prove fatal. As a matter of fact the best chance for the patient is to place him at absolute rest in the hope that the peritonitis may be more or less localised and that an abscess or, in the case of a perforating abdominal wound, a fæcal fistula may form.

CHAPTER XVII.

ACUTE INTESTINAL OBSTRUCTION.

Intestinal obstruction is a condition characterised by interference with the passage of the intestinal contents; it varies in degree from a comparatively slight difficulty to a state of complete occlusion in which neither fluids nor gas can pass.

CLASSIFICATION.—The symptoms accompanying the condition vary according as the obstruction is incomplete or complete, and in any case of simple interference with the passage of the contents they are more or less chronic and do not at first present any great urgency. But in many cases a totally different set of phenomena is met with, and the patient passes suddenly into a very grave condition. These are the cases included under the term Acute Intestinal Obstruction, and the condition implies not merely occlusion of the lumen of the bowel but also serious injury to and great disorder of the circulation in the bowel involved.

Hence intestinal obstruction may be divided into the acute and chronic forms, the latter being subdivided into the complete and the incomplete varieties. In the present chapter we shall deal with acute obstruction only and shall leave the chronic form for separate consideration (see Chap. XIX.).

SYMPTOMS.—These vary somewhat according to the nature of the pathological condition present, but it is by no means easy to diagnose the cause of the obstruction from the symptoms, with the exception of intussusception and possibly volvulus of the sigmoid flexure.

The history usually obtained is that the patient at the onset of the obstruction is in perfect health, and that with or without assignable cause, such as some strain or violent movement, he is suddenly seized with acute abdominal pain, usually referred to the umbilicus or the epigastrium, and soon accompanied with exacerbations of a colicky nature. Accompanying this there is marked collapse and pallor and the pulse is small and thready. Vomiting of the stomach contents and bile soon afterwards sets in; this however gives no relief, but is very distressing to the patient and is accompanied by constant nausea and eructations. There is complete consti-

pation; neither the solid nor the gaseous contents are passed, and the peculiarity of the constipation is that it is at once evident to the patient himself. In ordinary cases of constipation the patient only gradually becomes aware of the fact that the bowels are not acting; but here from a very early stage he feels that there is some difficulty in the onward passage of flatus and fæces and that if only they could pass he would be relieved. There is no tenesmus in the ordinary sense of the word. The temperature is subnormal and usually remains so throughout the case, although, if the patient live long enough for peritonitis to set in, it may be somewhat elevated. Thirst is very marked.

The abdomen in the first instance is flaccid and there is usually no tenderness on pressure in the early stages. Later on distension and meteorism become marked. As the case progresses, the vomiting continues and the character of the vomited matters changes, becoming gradually foul and fæcal in odour. The material vomited is the decomposing contents of the intestine which have a strongly marked fæcal odour and this condition is spoken of as stercoraceous vomiting. Very distressing hiccough sets in and the abdomen becomes distended, sometimes so greatly as to interfere with the respiration. The patient may recover somewhat from the initial collapse but gradually passes into an exhausted condition, the pain continues and he usually dies in a period varying according to the cause of the symptoms from a few hours to five or six days.

These symptoms indicate an obstruction to the passage of the contents of the intestine, accompanied by injury to the bowel wall—the conditions grouped together under the term *internal strangulation*. They may be mistaken for other conditions, or, more probably, other conditions may be mistaken for them, because any sudden injury to the peritoneum may give rise to very similar symptoms. Perhaps the condition most commonly mistaken for intestinal obstruction is the onset of acute peritonitis, such as follows perforation of the appendix, or even sudden acute appendicitis without perforation, but the symptoms differ widely when they are critically examined. The collapse is usually not so severe, although after a perforation of the appendix or of the stomach it is very marked. The abdomen becomes swollen much sooner than in cases of acute intestinal obstruction, and there is great tenderness. The temperature also rises almost from the first, and the vomiting is not such a distressing feature but usually passes off and does not return again for some time, while obstructive symptoms are not prominent at first, the patient being often able to pass flatus. Other possible conditions which may have to be considered on first seeing a case of this kind are the passage of a gall-stone or a renal calculus. Here the symptoms are very acute, but there is not the same collapse, whilst the character of the pain is different, being of a distinctly colicky type from the first, and being located in some special region, and not referred generally to the umbilicus. The persistence of the symptoms, the absence of pyrexia, and

the general course of the case usually however make the diagnosis quite clear.

PATHOLOGY.—In a case characterised by these symptoms various things may have occurred, but it is usually impossible from the symptoms present to say exactly what is the state of matters inside the abdomen. The most likely condition is *strangulation of a portion of the intestine under a band* resulting from antecedent peritonitis, and if there be a history pointing to a previous peritonitis, such as an attack of appendicitis, the chances that the condition is due to strangulation beneath a band are very much increased. These bands may consist of peritoneal adhesions uniting one portion of the intestine to another, or to the abdominal wall or to the omentum; as the result of the long-continued movements of the bowels these bands become stretched and form loops beneath which the intestine may be strangulated. In other cases the band may be due to the attachment of such organs as the appendix, Meckel's diverticulum or the end of the Fallopian tube to the intestine or the abdominal wall; or again, without any previous peritonitis, a long Meckel's diverticulum may coil itself around a portion of the intestine and so produce strangulation; or again, following possibly some previous injury to the abdomen, an aperture may be formed in the omentum or even in the mesentery, and intestine may become strangulated through the hole.

The portion of bowel strangulated beneath a band is practically always in the small intestine, usually the lower end of the ileum, and this is very important to remember in connection with the search for the obstruction. The most distended coils generally accumulate in the middle line at or below the umbilicus, and the seat of strangulation is very commonly to the right of this somewhere in the neighbourhood of the cæcum.

Similar symptoms may be caused by *herniæ*, and this point must always be investigated. For example the bowel may have passed into one of the natural seats of *external hernia* without having gone sufficiently far to give rise to a swelling recognisable from the outside. The aperture usually involved in such cases is the obturator foramen, and this should always be examined. Much more rarely there may be an *internal hernia*. As the result of contusions the diaphragm may be ruptured, and through the seat of rupture the so-called diaphragmatic hernia may occur—which is however not a hernia in the strict sense of the word. Among the true internal herniæ are hernia through the foramen of Winslow into the lesser peritoneal cavity, which is extremely rare. Another form is that known as Treitz's hernia or hernia into the fossa duodeno-jejunalis, which is formed by a fold of peritoneum behind the junction of the duodenum with the jejunum and which, although in the normal state it is a depression only admitting the thumb, may become gradually dilated until a large loop of the intestine passes into it. The sac has a narrow orifice and lies behind the peritoneum. As the hernia enlarges, the orifice of the sac travels downwards to

the right so that finally it may even be in the neighbourhood of the cæcum. The hernia becomes strangulated just like an external hernia. The neck of this hernia usually has large vessels, particularly the inferior mesenteric vein and a branch of the left colic artery above and in front of it, and, should it be necessary to operate on a case of this kind, the division of the neck of the sac is most safely made in the downward direction. Another form of internal hernia is known as the inter-sigmoid variety and occurs in the fossa formed by the layers of the sigmoid meso-colon and is situated about the bifurcation of the iliac vessels and to the left side of the sigmoid meso-colon; it is an excessively rare form. A fourth form is peri-cæcal hernia, which may be of three varieties; namely, the ileo-colic form which occurs in the fossa situated in the angle between the ileum and the commencement of the ascending colon, the ileo-cæcal situated further back, and the sub-cæcal behind the cæcum. All these forms of internal hernia are excessively rare and are about the last things to be looked for when opening the abdomen on account of symptoms of internal strangulation. In our own experience we have only met with two cases of internal hernia, one of which was into the fossa duodeno-jejunalis; the other was of the peri-cæcal form; we need not therefore further discuss these exceptional cases.

Other conditions which may give rise to somewhat similar symptoms are *acute kinking of the bowel* from the contraction of a band or from adhesions or compression of the gut by inflammatory matting together of the intestines. But these conditions are usually more chronic in their onset and do not begin with the collapse and other acute symptoms characteristic of internal strangulation. They will therefore be referred to again in connection with chronic intestinal obstruction, although they are really intermediate between the chronic and the acute forms.

Another condition which may give rise to similar symptoms is a *volvulus of the small intestine or of the cæcum.* Both these conditions are however extremely rare as compared with the ordinary *volvulus of the sigmoid flexure.*

Acute intussusception is another cause of these symptoms, but it differs very considerably in some respects from the foregoing forms of acute intestinal obstruction, and the majority of cases can be diagnosed before operation. It seems therefore more convenient to consider it separately (see Chap. XVIII.).

There is still another group of causes of acute intestinal obstruction that requires mention, namely, *blockage of the canal by foreign bodies*, of which the most common is a gall-stone. Here the symptoms are usually those of chronic rather than of acute obstruction, but sometimes they may arise quite acutely. Even here, however, the pain is not so great, and the other symptoms, especially the collapse in the early stages, are not quite so severe as in strangulation. This affection will be again considered in connection with chronic intestinal obstruction.

Changes produced by the obstruction.—As a result of the constriction of the bowel, changes take place both at the seat of strangulation and in the intestine above which require mention as they are important in regard to treatment. *The changes at the seat of constriction* essentially concern the circulation in the affected loop of intestine. The first effect of the constriction of the blood-vessels is engorgement of the veins, followed by œdematous infiltration of the loop, with the passage of fluid into the peritoneal cavity or the sac of the hernia, or even hæmorrhage into the intestinal wall. The constricted loop is at first swollen, glistening and purplish. When the constriction is relieved this gradually passes off, and the intestine gradually becomes redder and more healthy in colour. As the constriction becomes tighter the involved portion of the intestine continues to swell, and finally the circulation may be entirely cut off. The result is that the constricted intestine soon dies unless relieved; the loop loses its glistening appearance, becomes flaccid and soft, swells up and has a foul odour. The gangrene first occurs at the actual seat of constriction and, at any rate for a few hours after this, the rest of the loop may not be damaged beyond recovery. Perforation of the intestine results from the gangrene, and this again generally takes place at the constriction.

Changes also occur in the intestine above the obstruction.—The loop above dilates and often reaches a very large size from the development of gas within it. The loop is also congested, so that the intestine above the stricture can usually be easily distinguished from that below not only on account of its dilatation but on account of the marked congestion of its walls. This is a great contrast to the intestine below the obstruction, which is pale and empty. The fluid contents of the intestine above the obstruction rapidly undergo decomposition, and furnish the so-called fæcal vomit, which is really putrefying intestinal contents. If the obstruction be not relieved, paralysis of the bowel above will result, so that, even though the obstruction be removed, the paralysed intestine fails to pass on its contents.

The causes of death in acute intestinal obstruction are gangrene of the bowel, peritonitis, stercoral auto-intoxication, and, very rarely, shock. Even though the strangulation be relieved by operation, death may still occur from peritonitis, from perforation, from paralytic distension or kinking of the intestine, from auto-intoxication, or from septic pneumonia resulting from the passage of putrid vomited matter into the air-passages.

Just as it is difficult to diagnose the nature of the obstruction before operation, so is it difficult to ascertain its position. It is found as a matter of experience that the obstruction more often involves the small intestine than the large, obstruction involving the colon, with the exception of volvulus, being usually chronic; even in the latter the symptoms are somewhat delayed. When the small intestine is affected, the pain usually sets in very early and is most severe, whilst vomiting commences earlier and is more troublesome, and there is generally more severe collapse than when it affects the large bowel. On the other hand, meteorism is a more prominent and more

early feature in obstruction involving the large intestine, and in a volvulus of the sigmoid flexure this may reach an enormous degree. In acute obstruction evidence of movement of dilated coils can seldom be obtained, but this occurs frequently in the chronic form.

As to the actual seat of obstruction in the bowel, it is practically impossible to make a diagnosis. It has been said that the higher up the bowel the obstruction is the less is the amount of urine secreted, but that really depends rather upon the tightness and suddenness of the strangulation than upon its actual seat. Possibly early vomiting is more constant when the obstruction is high up in the small intestine, but this is an utterly unreliable symptom.

TREATMENT WHEN THE PATIENT'S CONDITION IS GOOD.

In many descriptions of acute intestinal obstruction the discussion of the treatment commences by reference to various medical measures, such as rest, morphine, and food. In acute intestinal obstruction however there is no medical treatment; the only thing that can give the patient the chance that he ought to have is immediate operation. It is true that a few cases in which the symptoms have pointed to acute intestinal obstruction and which have not been operated upon have recovered, either when left entirely alone or under the administration of opium, but these are extremely few in number and the diagnosis is exceedingly doubtful. It would be absolutely criminal to leave a patient unoperated upon on the infinitesimal chance that recovery without operation might occur, and we shall therefore not discuss the question of medical treatment at all.

The only question of treatment preliminary to operation has reference to *the administration of morphine*, which the medical attendant is sometimes tempted to prescribe as soon as he is called in and before he has made his diagnosis. Given in this way, morphine is a most dangerous drug because the symptoms may be masked for a prolonged period and the patient's chance from operation may be extinguished by delay. When however the diagnosis has been made, and while preparations are going forward for the operation, there is no objection at all to the administration of a small dose of morphine hypodermically in the early stages, as it relieves the urgent symptoms, causes diminution of the vomiting and the shock and improves the patient's general condition sometimes to a surprising degree. It should however only be given under these circumstances when the case is still in its early stages, as, if given after the obstruction has lasted some considerable time, even when used as an immediate preliminary to operation, it acts deleteriously by increasing the already existing paralysis of the bowel and may therefore diminish the patient's chance of recovery after operation.

As soon as the diagnosis of obstruction is made, operation should be carried out forthwith and quite independently of the ability to diagnose

the seat or nature of the obstruction.—In making preparations for the operation certain points must be borne in mind; in the first place the patient is sure to be already greatly collapsed and the operation, which must involve considerable manipulation of the intestinal contents, will indubitably tend to increase the shock. Hence the most vigorous measures must be taken to meet this emergency, and all the precautions mentioned in Part I., p. 139, and in connection with rupture of the intestines and perforation of the stomach (see pp. 177, 208), should be rigorously carried out. Apart from the administration of stimulants, the most important point is the diminution of the time occupied by the operation and here, as in cases of ruptured intestine, everything possible should be done, including shaving and purification, before the administration of the anæsthetic is begun.

A most important point, which should never be omitted in any case of acute intestinal obstruction, is to *wash out the stomach* before operation. The patient is constantly sick as the result of the obstruction and brings up most offensive and putrid material, and the vomiting is apt to be very profuse under the anæsthetic; more than once the material has actually passed in considerable quantity into the air-passages causing asphyxia or, as is more frequent, a subsequent septic pneumonia. The stomach should therefore be washed out in the manner already described (see p. 200) whilst the other preparations are being made and, unless the patient be excessively collapsed, he will submit to the procedure willingly and will indeed experience great relief from it.

As many of the coils of intestine are likely to protrude from the abdomen as soon as it is opened, plenty of hot abdominal cloths must be at hand to wrap them in. All needles should be threaded beforehand and, as it may be necessary to either resect and rejoin a portion of intestine or to form an artificial anus, the surgeon should always go to an operation of this kind provided with Mayo Robson's bobbins, Murphy's buttons, and Paul's tubes, so as to be prepared for emergencies. Suitable sutures should be ready threaded for any of these procedures.

The shock is probably aggravated to some extent by *the anæsthetic*, and in bad cases some surgeons prefer to operate with cocaine or eucaine anæsthesia rather than with a general anæsthetic. This may be necessary in cases that are almost moribund, but for our part we prefer to use either ether or the A.C.E. mixture, at any rate until the abdomen is opened, after which the administration should be reduced to a minimum.

The operative measures in these cases have three chief aims, namely: (1) The finding of the obstruction; (2) its relief; and (3) the subsequent treatment of the strangulated intestine.

THE FINDING OF THE OBSTRUCTION.—In practically all cases the abdominal incision should be made slightly to one side of the middle line as already described (see p. 188). It is never safe to trust to local symptoms, such as pain or swelling, as an indication of the position of

the obstruction, unless possibly in the case of an intussusception where a distinct lump may be felt. The incision through the abdominal wall should be free, and the greater part of it should lie below the umbilicus, but in all probability it will be necessary to extend it above it. The seat of obstruction very seldom appears immediately beneath the opening; the bowel usually found there is a dilated coil, and, as handling the intestines in these cases gives rise to considerable shock, a small incision is practically useless, and it will have to be at least six inches in length, and possibly more before the actual search for the obstruction is systematically undertaken.

As soon as the peritoneal cavity is opened, distended coils present in the wound and these are inspected to ascertain whether they are small or large bowel, as this at once gives a guide as to the position of the obstruction. It is also noticed whether fluid escapes, as this usually indicates severe strangulation, and the surface of the intestine is also examined for the presence of lymph, which indicates peritonitis and possibly perforation. The finger is then swept around inside the abdominal wall over the orifices of the various openings through which external herniæ take place, particularly the obturator foramen, which should be examined first. The finger is next passed down to the cæcum to ascertain whether it be empty or dilated; if it be empty the obstruction must be in the small intestine, whereas if it be distended the large bowel will be the seat of the mischief. The further procedure will depend somewhat upon the determination of this question. The above examination is about all that can be made through a three or four inch incision, which is the length usually made in the first instance.

The incision should now be enlarged with scissors to at least six inches, or even to eight or more if there be much distension. This should generally be done upwards. As the incision is enlarged and the edges of the wound are held aside, it will be impossible to prevent the escape of intestinal coils through the opening, and the search for the obstruction will be much facilitated by allowing them to escape into hot abdominal cloths which cover them up as they protrude. It is not usually necessary to pull out more coils of intestine than protrude spontaneously; it will generally be found on gently pulling on the distended coil that it is held somewhere, and, by following this up, the seat of obstruction will be encountered.

When the cæcum is dilated it is not so necessary to allow the intestines to escape, although it is hardly possible to prevent this in the majority of cases. The colon is traced from the cæcum upwards to the hepatic flexure along the transverse colon, and then, by displacing the intestines to the right side, downwards to the sigmoid. Should the case be one of volvulus, the large distended loop will be evident immediately on opening the abdomen.

This method of allowing the intestines to escape without actually eviscerating the patient is far superior to a blind search made by plunging the hand into the abdomen, or by pulling on individual coils of bowel. The

hand in the abdomen is an absolutely uncertain instrument which bruises dilated coils and sometimes even ruptures the peritoneal coat without any certainty that the search is being made in the proper direction to find the obstruction. On the other hand, by pulling upon the coil of bowel perforation at the seat of obstruction may be actually produced. The only objection to allowing the coils to escape in this manner is the difficulty experienced in putting them back when they are greatly distended. In most cases, however, it is undoubtedly well to empty the coils before any attempt is made to return them into the abdomen (see p. 323), and this difficulty is thus overcome. We strongly recommend that all gentleness should be observed in the manipulations, that the surgeon should have plenty of room, and that he should never attempt to pull or work in the dark.

RELIEF OF THE OBSTRUCTION.—The obstruction must be relieved after its position has been ascertained. Most frequently the cause of the strangulation is a band or an aperture in the omentum or mesentery, and if a band be found it must be divided. In long-standing cases the band itself may have become practically gangrenous and so soft that it tears through, and the obstruction is relieved immediately. If not, the band should be divided in the usual manner by inserting beneath it either a director or the finger-nail, upon which it is divided with a herniotome. The two ends of the band should be seized in forceps and each end should be cut away as completely as possible after division so as not to leave any loose tags which by adhesion might form fresh bands; a thick band should be ligatured before division. Omental adhesions should be dealt with in a similar manner. When the constriction is due to the adhesion of some structure, such as the tip of the appendix or Meckel's diverticulum, it may suffice, if the patient's condition be bad, to simply detach the adherent end. If, however, the patient can stand the extra time involved, it is well to remove the diverticulum or the appendix in the usual manner (see Chap. XX.) so as to avoid recurrence of the trouble. This of course prolongs the operation, and, unless the patient's condition be quite good, such a prolongation should be avoided. When, however, the constriction is formed by a Meckel's diverticulum twisting itself around the intestine, this structure must be removed in spite of the extra time required, because otherwise the obstruction might easily recur.

Any aperture in the omentum or mesentery should be dilated or enlarged by tearing so as to permit of reduction of the herniated intestine, after which the slit is sewn up. Acute kinking of the bowel from adhesions is rectified by careful detachment of the adhesions, which is often a matter of extreme difficulty. If the bowel be adherent to the abdominal wall the best plan is to detach it rather at the expense of the parietal peritoneum than to attempt to peel it cleanly off the intestine, as the latter structure may easily rupture. If one portion of the intestine be adherent to the other it will be necessary to separate the two and the greatest care is required to avoid tearing into the bowel.

Should no other cause for strangulation be found, the various situations of internal hernia should be remembered and carefully examined. Strangulation at the foramen of Winslow is almost impossible to relieve whenever the hernia is of any size because there is no part of the foramen that can be divided safely with the knife so as to relieve the obstruction. Hernia through a slit in the diaphragm is equally difficult to treat; pericæcal herniæ generally pull out easily and we have already referred to division of the stricture in a Treitz's hernia (see p. 316).

TREATMENT OF THE INTESTINE.—The treatment of the bowel after relief of the strangulation will depend upon the appearance it presents and also upon the state of the intestine above the constriction. The conditions met with may be divided into four groups:

1. **When the constriction is slight.**—In many cases the constriction has not been tight—indeed it may become released during the manipulations—the bowel has not been materially damaged and, on the relief of the constriction, the contents pass on freely from the intestine above. Here no further treatment is required for the intestine and the abdomen may be closed in the usual manner.

2. **When the strangulation is severe but the bowel is recoverable.**—The bowel above the constriction may remain distended in spite of the relief of the strangulation, so that the contents do not pass on properly, and the patient may be poisoned by them. This difficulty is due partly to the over-distended state of the bowel above and the consequent absence of proper peristaltic action, and partly to the fact that, as a result of over-distension, a series of kinks have occurred in the bowel above the obstruction which are not properly relieved when the lumen of the intestine at the seat of strangulation is restored. Under these circumstances it is absolutely essential to evacuate the bowel above the seat of obstruction before the abdomen is closed; unless this be done, the obstructive symptoms continue and the patient dies partly from them and partly from stercoral poisoning.

Evacuation of the bowel above the strangulation.—The coils of intestine, with the exception of that immediately above the seat of obstruction, are therefore returned into the abdomen and the greater part of the abdominal wound is closed. The coil which has been kept out is thoroughly packed round with warm abdominal cloths so as to prevent soiling of the peritoneal cavity. A long piece of drainage tube (No. 24) is taken and a small opening, just large enough to allow the insertion of the tube and nothing more, is made in the convex border of the loop, the bowel being compressed above and below while the opening is being made, and the end of the drainage tube inserted into it. The other end of the tube is placed in a suitable receptacle and then the compression is relaxed and the contents of the bowel are allowed to flow away. As a rule in bad cases only a small portion escapes, that is to say only the portion in the loop punctured and up to the kink above. When the flow ceases,

the drainage tube should be gradually pushed upwards along the bowel so as to pass into the next coil above, and this is continued until satisfactory evacuation of the intestine above has been obtained. During this period the exposed portion of the coil is kept warm by the ordinary hot abdominal cloths, and the patient is allowed to come round from the anæsthetic. The object of using a tube instead of making a small opening is to allow of the evacuation of the coils above, which may not empty themselves at once through the opening, and without the use of a tube one can never be quite certain that the object has been completely obtained. The tube will pass onwards more easily if lubricated with a little glycerine before its insertion. There should be no hurry over this procedure; before completing the operation the surgeon must be satisfied that the intestine has been thoroughly evacuated, and it may be a matter not of a few minutes but of even an hour or longer before it seems safe to close the opening and the abdomen. This procedure may seem somewhat heroic, but it is not really so if carried out with proper care; of its absolute necessity no one who has practised it can fail to be convinced. It is a precaution that is far too often neglected, and in the large majority of cases we are certain that it makes all the difference between recovery of the patient and failure of the operation. A point of the highest practical importance is to see that the patient is kept thoroughly warm throughout the entire proceeding; blankets, hot-water bottles, etc., must be renewed as often as is necessary, and stimulants also should be administered if needed.

When the surgeon is of opinion that the coils have been sufficiently emptied, the tube is withdrawn, the intestinal walls above and below the small opening are temporarily approximated by the assistant's fingers, and the incision itself is rapidly closed with a fine continuous Lembert suture (see p. 213). A single row will suffice if it be commenced and terminated about a quarter of an inch beyond the extremities of the incision. The bowel is then carefully cleaned up, the loop dropped back into the abdomen, and the closure of the abdominal wall proceeded with (see p. 189).

3. **When the bowel is not likely to recover.**—Here the condition of the intestine may be similar to that just described, but in addition the seat of constriction remains kinked as the result of inflammatory infiltration and, even though the bowel above be evacuated, the kinking remains as a permanent obstacle to the onward flow. When the bowel is as severely constricted as this, gangrene and perforation are very likely to occur at the seat of constriction and hence, in addition to evacuation of the bowel, the affected portion must be excised and an end-to-end union established.

Enterectomy is done in the first instance in the usual manner; clamps are applied and the affected portion is removed as already described (see p. 306), but in these cases it is not necessary to take away much of the mesentery because there is no thrombosis of the vessels. There is a certain difficulty in the anastomosis owing to the dilatation of the bowel above the seat of constriction and therefore it is well to employ Mayo Robson's bobbins by

which the calibre of the dilated portion can be diminished easily so as to accurately fit the lower one. Where speed is all-important Murphy's button may be used. Some surgeons have proposed to sew up the divided ends of the bowel and then to do a lateral anastomosis in order to avoid joining the dilated to the collapsed bowel end-on. If Robson's bobbin be used however the latter operation is easy and it is better in every way than a lateral anastomosis; it is done more quickly and the opening is more satisfactory and has not the same tendency to contract that the lateral opening has. At the same time lateral anastomosis is better than end-to-end suture without any artificial aid in these cases, as it is extremely difficult to approximate a dilated to a collapsed portion of bowel by mere simple suture.

After the intestine has been united, a second opening is made higher up and *the intestine is evacuated* as already described (see p. 323). This seems to be better than to try to evacuate the bowel through the open end of the upper segment. The evacuation may take a long time, during which the lower end of the bowel is also open and it seems better to complete the union of the bowel as soon as possible and to have an independent opening than to delay it for an hour or more; besides this, the open end of the intestine does not grasp the tube in the same way that a small opening in the convexity higher up does and hence there is a greater risk of soiling.

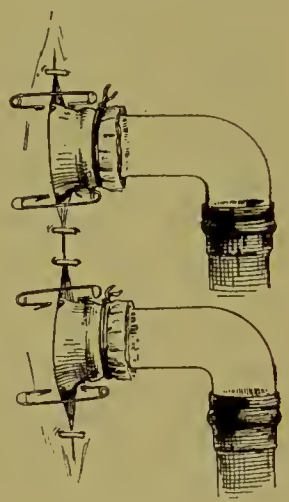


FIG. 95.—PAUL'S TUBE AS USED TO ESTABLISH AN ARTIFICIAL ANUS. The large bowel has been cut across and a colon tube tied into each end. The sketch shows how the gut is prevented from shifting its position by the safety-pins thrust through its sero-muscular coats. Two stitches bring the skin together between the tubes and thus shut off all communication between the two ends of the bowel.

In bad cases it may be better to tie a Paul's tube (see Fig. 95) into each open end of the intestine after resecting the loop and so to make an artificial anus to be remedied afterwards, but the method just described is preferable if it can be done. When Paul's tubes are used, one of suitable size should be taken for each opening and each should be provided with a long piece of india-rubber tubing through which the contents of the intestine may escape into a receptacle at the side of the bed. A tube is slipped into each open end and fastened by tape which secures the wall of the bowel firmly in the flange; this is done before the clamps are taken off. The bowel is now cleaned up, the packing removed and the abdomen closed as quickly as possible; time may be saved by fixing the bowel above and below to the abdominal wall with safety-pins which pick up the sero-muscular coat instead of accurately stitching it round the opening.

This does not however complete the case, for the surgeon must see that the upper portion of the intestine is evacuated efficiently through the Paul's tube just as in the previous case. This may sometimes be done by filling up

the tube with water and so forming a syphon arrangement; in others a smaller indiarubber tube may be introduced through the open end of the glass one and may be pushed into the coils of intestine above, or an attempt may be made to suck out the contents of the bowel with an evacuator. The surgeon must be satisfied that the contents of the upper portion of the intestine are escaping freely before he leaves the patient.

The ring of intestine constricted by the tapes usually sloughs in about three days and then both the tubes become loose and must be removed. By that time sufficiently firm adhesions have occurred to prevent extravasation of the contents and there is little risk of septic infection. When the patient has recovered, the closure of the artificial anus must be taken in hand (see Chap. XXIV.). Where the opening is in the small intestine this must be done comparatively early for two reasons: in the first place because nutrition is seriously interfered with by the escape of the contents of the small intestine; and in the second place because these contents are very irritating and cause excoriation of the abdominal wall.

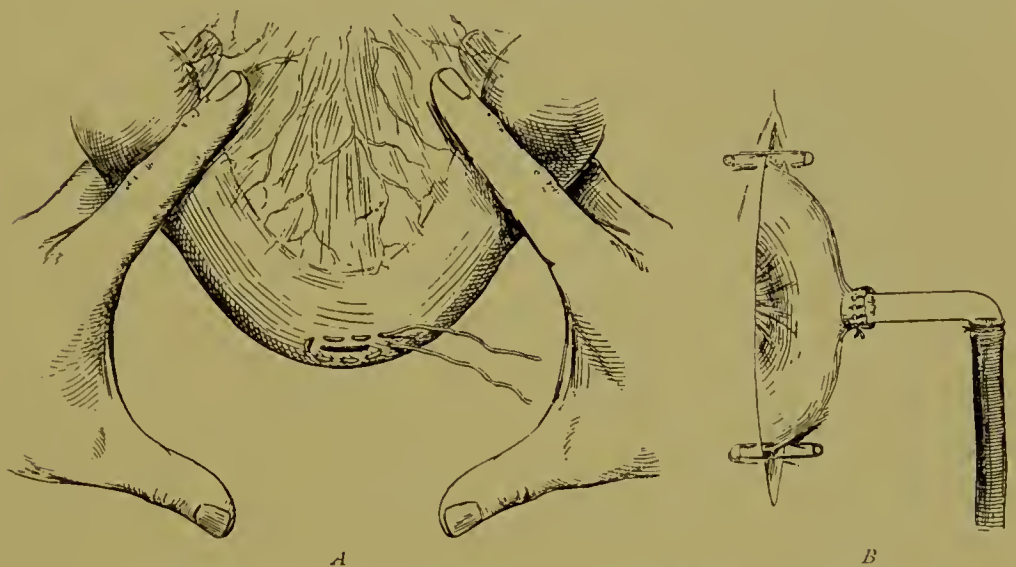
4. When the bowel is actually gangrenous.—The gangrene may be either at the point of constriction alone or may affect a portion or the whole of the strangulated loop. It is out of the question here to return the loop into the abdominal cavity, and *excision of the affected portion* along with a large V-shaped portion of the mesentery (see Fig. 92) is essential; when that has been done, an end-to-end anastomosis or an artificial anus is made according to the condition of the patient. The ideal treatment is to excise the affected portion and to make an accurate end-to-end anastomosis, but frequently the patient cannot stand the shock of such a procedure, and an artificial anus must be established. The treatment in both cases is exactly the same in every respect as that described for the last group of cases (*vide supra*), with the exception that a large V-shaped portion of the mesentery must be removed here, because the vessels are extensively thrombosed and, if the mesentery be left, this thrombosis may spread to other vessels, and so produce gangrene of the intestine left behind.

TREATMENT WHEN THE PATIENT IS *IN EXTREMIS*.

The foregoing procedures apply to cases in which the surgeon is called in before the patient is absolutely moribund; should he be upon the point of death when first seen, however, there is no possibility of his surviving any of the procedures we have described, and the question that arises is whether nothing at all should be done, or whether there is any temporary measure that is at once rapid, devoid of shock, and likely to be of benefit.

Unless the patient be literally going to die within a few minutes, it may be possible to open successfully the most distended loop of bowel without making any attempt whatever to remove the obstruction. This can be readily done through a small incision in the middle line under cocaine anæsthesia by hypodermic injection by Schleich's method (see Part I., p. 123). The dis-

tended loop at once protrudes, is seized and clamped by the fingers of an assistant, and a continuous purse-string suture is passed through the walls of the bowel as for the introduction of Murphy's button in gastro-enterostomy (see p. 263), a small slit is made in the bowel and a Paul's tube rapidly slipped in, and the suture tied so as to fix it in position (see Fig. 96). The open end of the tube should be fitted with india-rubber tubing so as to convey the contents of the intestine well away from the wound. The bowel



A *B*

FIG. 96.—PAUL'S TUBE AS USED TO ESTABLISH A FÆCAL FISTULA IN THE SMALL INTESTINE. The introduction of the purse-string suture is shown in *A*. When the suture is in place the bowel is opened, the smaller tube is inserted and tied in, and the loop of bowel is fastened to the skin as is shown in *B*.

is secured in the wound, the edges of the incision and the bowel being brought together by passing sterilised safety-pins through them above and below, taking care to take up the sero-muscular coats alone.

This procedure is only to be adopted when it is absolutely impossible to do anything else, and is merely a temporary measure; should the patient be lucky enough to recover, the abdomen must be subsequently opened, the obstruction searched for and remedied, and the artificial anus closed. It is most remarkable what a number of cases have recovered after a temporary measure of this kind, and we can only assume that in them the strangulation had not reached such an extent as to produce actual gangrene, and that with the subsidence of the distension the strangulation passed off.

After-treatment of cases of acute intestinal obstruction.—Little need be said about the after-treatment of these cases as it does not differ in any material manner from that appropriate to intestinal injuries which has been fully dealt with (see p. 312). As a rule even greater attention has to be paid to the question of stimulating the patient freely, on account of the severe auto-intoxication that occurs as the result of the long-continued absorption of putrefying intestinal contents, and another point of the greatest importance is to avoid the use of opium or morphine as much as possible. It is more important in intestinal obstruction than

in any other cases to avoid paralysis of the intestine which would inevitably promote the auto-intoxication from which the patient has already suffered so much. In all cases therefore, whether the intestine be returned unopened, whether it be merely evacuated and returned, or whether a resection has been performed, the administration of opium should be restricted entirely to the relief of severe pain. At the same time the action of the bowels should be promoted, copious enemata being given daily from the end of the first 24 hours, whilst a saline aperient may be given by the mouth at the end of the fourth or the fifth day. From the time that the bowels become well opened the patient's condition generally improves with great rapidity.

The principles guiding the question of feeding will be the same as those laid down for the treatment of intestinal injuries (see p. 312). When an artificial anus has been made and the patient recovers, the case becomes one of artificial anus which must be treated on the lines suitable for that condition (see Chap. XXIV.).

VOLVULUS OF THE SIGMOID FLEXURE.

PATHOLOGY.—In volvulus of the sigmoid flexure the pathological conditions may be various. There is a twist of the sigmoid loop, varying from a half to one or more complete circles, and the result of this is interference with the circulation through the meso-sigmoid, which is directly proportionate to the severity of the twist. The torsion also interferes with the flow of intestinal contents which become confined within the twisted loop. There is subsequently an enormous development of gas and great distension of the abdomen may result, the distension being in the loop itself rather than in the intestine above. Unless the condition be relieved, lymph very soon mats the base of the loop with adhesions which render its untwisting difficult. In severe cases the circulation becomes increasingly interfered with, and gangrene, spreading from the point of torsion, may occur in the loop. Peritonitis occurs early. The upper part of the loop is usually rotated so that it passes in front of the lower, but in some cases the exact opposite takes place. Occasionally the volvulus may be most complicated; the small intestine may also be involved, and there may even be a winding of the small intestines round the large.

SYMPTOMS.—These differ somewhat from those of internal strangulation, and a suspicion of the true state of affairs may often suggest itself before operation. In the first place the patients are usually older than those who are the subjects of internal strangulation, although of course this is a point upon which no great stress can be laid. There is often a previous history of constipation, one of the chief predisposing causes of the mischief being distension of the loop of the sigmoid and the resultant stretching of the meso-sigmoid which follows the constant overloading of this portion of the intestine with fæcal contents. The onset is sudden, as in the

other cases, but the pain, although severe, is not usually quite so bad as in internal strangulation, whilst the colic is more marked. Vomiting is not so urgent as in internal strangulation; constipation of course exists, but the collapse is usually not so marked, while one of the great symptoms which gives rise to a suspicion of this condition is the early and great distension of the abdomen.

TREATMENT.—The treatment is very difficult. Attempts must be made to untwist the intestine, but the torsion is often complicated, one coil being wrapped around another so that it is extremely difficult to make out the exact manner in which the trouble should be remedied. At the same time, however, it is absolutely essential that this should be done, and the best plan is to get the loop at once out of the abdomen as otherwise it is quite impossible to see the precise condition of affairs. Even when this is effected, the enormous distension of the coil usually hides the seat of volvulus, and attempts to manipulate the bowel are apt to cause rupture, at any rate of the peritoneal coat about its base. We should therefore advise that, as soon as the distended loop has been got well out of the abdomen, it should be packed all around with abdominal cloths, a dish placed beneath the most prominent portion of the loop and a small incision made into it so as to completely evacuate the contents. It is then possible to manipulate it properly. After the loop has been emptied, the small hole should be cleansed and sutured before proceeding further with the operation. It is seldom that the colon above is so distended as to interfere with the subsequent steps of the operation, but if so it should be brought out over the side of the abdomen and its contents evacuated in turn; but this should be avoided if possible, as it is a difficult matter to get the colon well out of the abdomen.

When the twisted loop has been evacuated, it is carefully examined to see in what direction the twist is, whether from right to left or *vice versâ*, and whether the loop is twisted around itself or whether one coil of intestine is twisted around another. In order to untwist it, the whole mass should be grasped between the surgeon's two hands and rotated bodily in the opposite direction to that in which the volvulus has occurred. If the twist be of recent date, the lumen of the bowel is at once restored, and there is no great risk of recurrence. When, however, it has lasted for several hours, the tissues around the neck of the volvulus are much infiltrated with lymph and not only is the unwinding very difficult and unsatisfactory, but the coil is apt to re-wind again as soon as the pressure is released. Should this be so, it is advisable to stitch the meso-sigmoid to the abdominal wall or to the iliac fascia. The stitches must not be introduced through the bowel wall as they might easily tear through and lead to perforation. If any reinforcement of those in the meso-sigmoid be required, the loop may be moored by the appendices epiploicæ.

Should it be impossible to untwist the volvulus, or should the mass be gangrenous, the outlook is excessively grave, for the surgeon has no alter-

native but to resect the entire mass—a procedure which is generally more severe than the patient can stand. To form an artificial anus in the loop does no good, because the affection is left untouched and the gangrene will proceed uninterruptedly. Where, however, the patient cannot possibly stand the necessary resection, it may possibly suffice to make an artificial anus both in the involved loop and also into the colon above by the aid of Paul's tubes (see p. 327). This, however, is a desperate remedy, and is only to be adopted when it is absolutely impossible to do anything else.

CHAPTER XVIII.

INTUSSUSCEPTION: OBSTRUCTION AFTER LAPAROTOMY.

ACUTE INTUSSUSCEPTION.

Intussusception is a very common form of intestinal obstruction of which it forms more than a third of the cases. It is by far the most common form of obstruction in children, and is almost the only one met with in infants. In it a portion of the bowel becomes invaginated into the gut below, so that the intestinal canal is doubled upon itself and consists of three layers, the upper one being inverted into and encased by the lower. This occurs most frequently at the ileo-cæcal valve and in nearly one half the cases is formed by the lower end of the ileum passing into the cæcum, the apex of the invaginated portion being the ileo-cæcal valve. This form is called the *ileo-cæcal* intussusception. The next most common form is the *enteric*, in which one part of the small intestine, generally the jejunum, is projected into the part below. Much more rare than this are the *colic* intussusceptions, where one portion of the large intestine is received into another. This is most common about the sigmoid flexure and upper end of the rectum. The rarest form of all is the *ileo-colic*, in which the ileum passes through the ileo-cæcal valve and projects into the colon. There are other excessively rare forms which do not require mention here.

CAUSES.—Intussusception is due to various causes, the chief of which is probably irregular contraction of the intestine. In infants the affection is usually preceded by some intestinal disturbance such as diarrhœa and, owing to irregular contraction of the bowel, a portion of the contracted intestine passes into the lumen of the bowel immediately below. As a matter of fact it is not so much a projection of a contracted portion of intestine into that below as what has been spoken of as a swallowing of the contracted bowel, that is to say, it is not a passive pushing down of a narrowed portion into a wider one but an active taking-in of the former into the latter. The actual exciting cause varies. Sometimes it is irregular contraction associated with diarrhœa; it may also be brought about by foreign bodies or the presence of

growths on the wall of the intestine, particularly the polypoid forms which, hanging into the bowel, lead to irritation and irregular contraction so that the polypus is dragged down and pulls the bowel after it. Small cancers have in this way formed the apex of an intussusception which has even protruded from the anus.

PATHOLOGICAL CHANGES.—It is important to note that the apex of an intussusception is a constant point. The increase in length of the tumour is obtained at the expense of the lower portion, which becomes more and more invaginated; as the apex travels on, it causes reflection of an increasing portion of the receiving layer. An intussusception is always described as consisting of three parts, the intussusceptum, or the part drawn in; the intussuscipiens, or the receiving layer; and the reflected portion, or the part of the intussuscipiens which is bent upon itself. Thus, counting from without inwards, there are three complete thicknesses of the bowel wall concerned in any case of intussusception; namely, the outer wall of the intussuscipiens, the inner or reflected layer of the latter, and the intussusceptum.

A very important anatomical point arises in connection with the presence of the mesentery. As the intussusceptum travels further along, the mesentery becomes more and more constricted as it passes over the neck of the intussuscipiens, and steadily increasing interference with the circulation in the included loop takes place, while, owing to the pull upon the mesentery, there is an alteration in the direction of the intestinal tube and the calibre of the intussusceptum. The vessels in the mesentery being constricted, the intussusceptum and the reflected layer become œdematous and swollen, and if the constriction at the neck of the intussuscipiens be tight, the circulation in the intussusceptum may become entirely arrested. The result of this is hæmorrhage into the intestine and inflammation of the mucous membrane, which give rise to the chief symptoms of intussusception, namely, the passage of mucus and blood. When the constriction is very tight, the interference with the circulation may be so severe as to cause gangrene, and in the great majority of cases this occurs in from four to five days and usually involves the whole length of the intussusceptum.

Another effect of the presence of the mesentery is obstruction to the passage of intestinal contents through the intussusceptum. In the early stages, before much swelling or alteration in the direction of the canal occurs, the liquid contents may pass on. As the swelling becomes more intense the obstruction becomes greater, and this is increased by the fact that, as the intussusceptum increases in size, it curves towards the mesenteric border until finally its apex becomes more or less firmly pressed against the wall of the intussuscipiens and a mechanical blockage is added to that produced by the swelling. Further, the pull of the mesentery causes the opening of the apex of the intussusceptum to become changed from a round hole to a elongated slit which still further increases the obstruction.

When this obstruction is thoroughly established there is no passage of the intestinal contents from above the seat of mischief although the patient's

bowels may be acting freely; all that is passed is a large quantity of mucus and blood derived from the inflamed bowel in the vicinity and the engorged vessels of the intussusceptum. This swelling of the intussusceptum due to the interference with the blood-supply forms one of the chief obstacles to the reduction of the intussusception. The intussusceptum soon becomes so swollen that it cannot be got out of the intussuscipiens without considerable force, and attempts to reduce it in its swollen condition may, and very often do, readily lead to cracks in the wall of the intussuscipiens, which may sometimes even involve all the coats and which certainly involve the peritoneal coat extensively.

Among the other changes which occur as the result of this condition is an adhesive peritonitis between the opposed peritoneal coats of the intestine. Peritonitis occurs between the reflected layer of the intussuscipiens and the wall of the intussusceptum, provided always that the latter be still alive; if it be gangrenous, no peritonitic adhesions form between it and the ensheathing layer except at the neck of the intussuscipiens where the two layers of the intestine become matted together. The occurrence of peritonitis at the neck of the tumour has a twofold result. While on the one hand it forms a certain obstacle to reduction, although the importance of this is probably much exaggerated, on the other hand it is Nature's protection to the patient, because, if firm peritoneal adhesions occur around the neck, he may live until the gangrenous intussusceptum has separated and the continuity of the bowel may thus be restored without any perforation having taken place into the peritoneal cavity.

SYMPTOMS.—The symptoms to which this condition give rise are briefly those of acute intestinal obstruction, to which are super-added others so distinctive that an intussusception can generally be diagnosed from the other forms of acute intestinal obstruction. The onset is generally rapid and accompanied by collapse and vomiting and the other general symptoms of acute intestinal obstruction already detailed (see p. 314). *The distinctive symptoms* are constant tenesmus, which is especially marked when the intussusception is of the colic variety, or when an ileo-cæcal intussusception has reached the rectum; there is a constant desire for the bowels to act and this is not, as in other cases of intestinal obstruction, fruitless but is accompanied by the passage of mucus tinged with blood and sometimes with a certain amount of fæcal matter. An abdominal tumour soon forms which takes a sausage-shape and which is most commonly found in the right iliac region; it is not always easily made out, even when the patient is under an anæsthetic, because it sometimes passes up under the ribs and may be entirely concealed there. Usually however it can be felt, at any rate in the early stages, under an anæsthetic. It varies somewhat in consistence and it can often be noted that the tumour either changes its position or alters its shape.

These symptoms serve to diagnose the condition from other forms of intestinal obstruction, and besides this the age of the patient is an important

element; acute intestinal obstruction in infancy without an external hernia is practically always due to intussusception.

RESULTS.—Acute intussusception is very fatal in young children and usually causes death in three or four days. Occasionally, especially in older subjects, it may be followed by recovery which ensues as a result of gangrene of the intussusceptum accompanied by soldering of the neck of the intussuscipiens to the intestine above. These cases are usually followed at a later date by annular constriction of the bowel and symptoms of chronic intestinal obstruction.

Spontaneous reduction of the intussusception is very rare, although some hold that it can readily occur. The period at which the intussusception can be easily reduced is usually very short, as a constriction of the mesenteric vessels of comparatively slight duration leads to so much œdematous swelling of the intussusceptum that its reduction is rendered difficult. This to some extent depends upon the anatomical form present, and is most rapid in the ileo-colic form in which the ileo-cæcal valve grips the small intestine extremely tightly and leads to rapid and complete strangulation.

TREATMENT.—The only form of treatment admissible is reduction of the intussusception immediately the diagnosis is made. The case cannot be watched, the surgeon is not justified in hoping for spontaneous recovery and the sooner active steps are taken the better. There are two forms of treatment which aim at reducing the intussusception, which may be termed the operative and the non-operative.

In the non-operative treatment an attempt is made to force back the intussusceptum from below by injecting air or fluids of various kinds into the bowel so as to distend it and exert pressure on the apex of the intussusceptum and to force it out of the intussuscipiens. The operative measures consist in opening the abdomen, exposing the tumour and squeezing the intussusceptum out of its sheath.

Non-operative measures.—Up till comparatively recently the classical method of reducing or attempting to reduce intussusceptions was by injections from the lower bowel, and a number of cases recover by this method, especially if the attempt be made quite early, that is to say within the first few hours after the onset of the affection. There are however a number of objections to the method. We may summarise the chief objections as follows:

1. It is only useful within the first twelve hours and, if the surgeon places much reliance on the method, he may be led to try it long after the time for its success has passed.

2. Even under the most favourable circumstances, namely, when applied immediately after the intussusception has occurred, the method does not succeed in anything like half the number of cases.

3. The point of greatest importance is that there is very great uncertainty as to whether the method has succeeded in any given case and several hours must elapse before this fact can be definitely ascertained:

that is to say, the surgeon may conclude at the time of the operation that the tumour has completely disappeared and yet, soon after the patient's recovery from the anæsthetic, the symptoms may set in anew and thus valuable time may be lost.

4. The patient is exposed to a double shock when the method fails, because the distension of the bowel is not unaccompanied by shock and, if it fail, the extra shock caused by the necessary laparotomy is likely to prove fatal.

5. The method is absolutely of no use in the true enteric form or in the ileo-colic varieties and it is not always possible to diagnose which variety has to be dealt with.

6. The method in careless hands may actually kill the patient from rupture of the bowel.

Operative measures.—Hence, in our opinion, it is much better, when leave can be obtained, to proceed at once to perform a laparotomy. It is not necessary to make a large opening because the laparotomy may be combined with distension of the bowel, and may be employed more for the purpose of ascertaining that a complete reduction of the intussusception has been obtained than as a means of actually reducing it.

Combined laparotomy and injection.—In the first instance an incision is made into the abdominal wall just large enough to admit one or two fingers. The seat of this incision will vary. If the position of the intussusception be easily made out, it is best made towards the neck of the tumour, and, as quite half the cases are ileo-cæcal in character, the incision will be in the cæcal region. When the seat of the intussusception is not so well marked, it will perhaps on the whole be better to make the incision in the middle line just below the umbilicus.

When the intussusception appears to be ileo-cæcal in type, the incision is made about the level of the anterior superior spine, very much as for removal of the appendix. It should be made outside the linea semilunaris with its centre opposite the anterior superior iliac spine, and the abdominal muscles should be split as already described (see p. 188). When the peritoneum is opened, one or two fingers should be introduced, the lump felt for and the finger hooked round it. This is often facilitated by pushing down the lump into the neighbourhood of the opening by the hand upon the abdominal wall outside. The exact character of the intussusception may often be ascertained by the touch and, if the finger can reach to the lower end of the intussusception, it is often possible, by gently pressing the tumour against the abdominal wall with a couple of fingers, to gradually squeeze the intussusceptum out; if this can be done there is no need for inflation of the bowel or any further enlargement of the wound. Gentle pressure exercised from the lower part upwards may succeed in expressing the intussusceptum in early cases when marked changes have not occurred. If the intussusception yields in this manner and reduction is complete, it is easily ascertained by hooking out the cæcum with one finger. In

doing this the surgeon must be very careful not to pull upon the small intestine but to hook out the bowel by pulling upon the colon below the seat of intussusception; if the intussusceptum be pulled upon, the coats of the intestine may be torn. When reduction is not quite complete it can be readily effected by grasping the small lump that is left in the hand and making gradual pressure on it through the cæcum so as to squeeze out the ileo-cæcal valve. In no case should any attempt be made to reduce it by pulling upon the intussusceptum.

If this gentle compression against the abdominal wall does not effect the reduction it is well, instead of at once enlarging the abdominal wound, to distend the large intestine, and to see how far moderate pressure will reduce the intussusception. The distension of the bowel may be effected with air or with fluid, of which the latter is probably the better, as it is on the whole more under control. The fluid employed should be hot milk, which has the advantage that it leaves a nutrient material in the bowel which may help to overcome the shock. It should be introduced into the bowel by mere hydro-

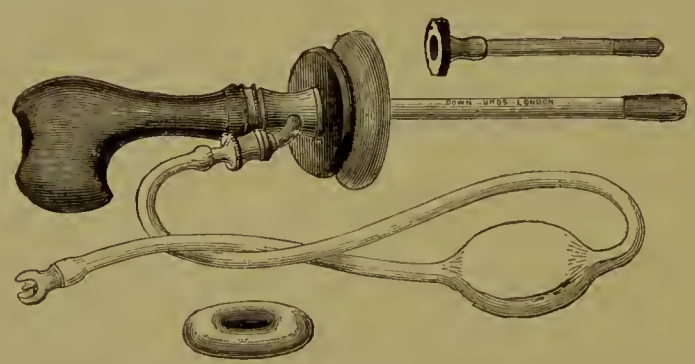


FIG. 97.—LUND'S INSUFFLATOR. It is advisable in practice to substitute a tube and funnel for the Higginson syringe here figured.

static pressure and should never be forced in by a pump; the introduction should be very gradual, so as to allow the fluid to find its way up along the colon. The nozzle of an enema syringe or a vaginal tube is attached by at least three feet of india-rubber tubing to a funnel, and the fluid is poured into it, the funnel being elevated about three feet above the level of the body.[1] The tube should be passed several inches up the rectum if possible, and wool should be packed tightly around the tube and the buttocks firmly pressed together; the latter should also be raised upon a pillow so as to facilitate the passage of the fluid by gravity. A special insufflator has been introduced by Mr. Lund (see Fig. 97) to completely block the anal orifice and prevent regurgitation. The funnel and the tube should be filled with milk before the nozzle is introduced into the anus in order to expel all air before introduction, and a clamp is arranged on the tube so as to regulate the flow. The amount of fluid introduced will depend upon the age of the patient. According to D'Arcy Power, the capacity of the colon varies from

[1] This part of the procedure must be carried out by an assistant who takes no part in the laparotomy.

ten ounces in a male child of five months to a pint or more in a child a year old.

The fluid should be introduced very slowly, and probably ten minutes or a quarter of an hour will elapse before any distinct effect upon the intussusception is noted. The finger in the abdomen will appreciate the gradual distension of the colon with fluid, and reduction may be facilitated by gentle pressure on the lower end of the intussusceptum by the fingers in the abdomen, and, if the intussusception be felt to yield, this pressure should be kept up until reduction is complete or until further yielding ceases.

In the former event nothing further is required except to close the abdominal wound but, should reduction be incomplete, the fluid is allowed to escape from the bowel and the operation is completed either by hooking out the remains of the intussusception through the opening, or, if necessary, enlarging the latter upwards so as to permit of freer manipulation. Reduction is then effected by squeezing the intussusceptum out of the intussuscipiens.

This so-called "combined method" is probably accompanied by less shock than is reduction of the intussusception by laparotomy alone but it is only useful in the colic or ileo-cæcal forms. Our experience of the procedure is that it is accompanied by remarkably little shock, and we attach considerable importance to the gentleness and slowness with which the attempt to reduce the invagination is carried out. This is particularly the case with regard to the gradual injection of the fluid; at least a quarter of an hour should be employed in injecting the fluid into the bowel, and another five minutes should be allowed for the pressure to take effect before any attempt is made to hook the intussusception out.

After-treatment.—When reduction is complete, the wound is sewn up in the usual manner, and the various measures suitable for severe shock (see p. 177) are employed. In these cases, unlike those of acute intestinal obstruction in general, opium is extremely beneficial. The dose and method of administration will vary largely with the age of the patient; the important point is to secure the sedative action of the drug upon the peristaltic movements of the intestine.

Laparotomy alone.—The chances of success by the combined method described above are restricted within somewhat narrow limits. Although by far the most valuable method in early cases, it is not likely to succeed after about twelve hours have elapsed since the occurrence of the intussusception, although it is impossible to lay down any definite rule upon this point as the conditions vary so greatly. In all probability however the intussusceptum will be so swollen and such considerable adhesions will have formed about the neck after that time that the chances of reducing it by pressure from within the bowel are very slight. Therefore in these cases more summary measures must be adopted and their nature will depend upon the conditions found; an immediate laparo-

tomy must be done, which should by preference be close to the middle line (see p. 188) because a fairly considerable incision must be made, the hand must be introduced and the intussusception brought out of the abdominal wound. No doubt it is difficult to bring an intussusception chiefly involving the ascending colon out of a median abdominal incision unless the latter be made of extra large size and be firmly retracted to the right side, but on the whole we prefer a median incision as being most suitable for the majority of cases; if it should be found necessary to add a lateral incision at a later stage, the extra shock is not really great. When the abdomen has been opened the intestines should be packed over to the side opposite that on which the intussusception has occurred with abdominal cloths.

If the case be of the ileo-cæcal form the intestines are packed over to the left side and the tumour is brought into view. The left hand should then grasp the swelling and, after forcible retraction of the right side of the abdominal incision, the surgeon endeavours to ascertain the condition of the neck of the tumour without extruding it from the abdomen before he proceeds further. This is very important for two reasons. In the first place, it is essential to see whether there be any signs of gangrene at the neck—in which case no attempt must be made to reduce the tumour—and in the second place it is necessary to watch what happens to the intussuscipiens at the neck of the tumour—such as splitting of the peritoneal and muscular coats—when attempts are made to reduce it. On no account must efforts be made to reduce the tumour in the dark.

The best and safest method of reduction is to grasp the lower part of the swelling in the left hand so that it lies completely surrounded in the palm; then, by a very gentle squeezing movement, the apex of the intussusceptum is pushed up, and as it goes it will unroll the intussuscipiens. This onward pressure should be very gentle and slow so as to avoid rupture of the coats, while it should at the same time be fairly firm so as to gradually reduce the œdema at the apex of the intussusceptum. In the great majority of cases it will be found that the greater part of the intussusception is reduced quite readily in this way; the difficulty is with the last part. A point is eventually reached at which the intussusceptum is firmly wedged into the intussuscipiens, not so much by adhesions as by the swelling at the apex of the former. The surgeon must on no account be tempted to try to pull out the intussusceptum, for that is quite futile. The invagination cannot be more readily reduced thus than by squeezing it, and there is in addition the great risk of tearing the neck of the intussusceptum which has been constricted and which may be on the verge of gangrene; if it will not squeeze out it will not pull out. At this stage the tumour can generally be brought out of the abdomen and packed around with warm cloths so that the rest of the operation can be done in the open. If a cautious continuation of the pressure reduces the intussusception well and good; any slight splitting of the

outer coats that accompanies reduction can be stitched up with a fine catgut suture (see p. 213), the bowel dropped back and the abdomen closed.

At this stage however the surgeon is often faced by one of the complications already referred to; the intussusception may be either irreducible or both irreducible and gangrenous. In either case to leave the intussusception untreated would lead to the patient's death, and the further procedure will depend partly on which of these conditions is present, and partly on the state of the patient.

When the tumour is irreducible but not gangrenous.—The ideal treatment is to excise the involved portion and practise an end-to-end anastomosis; this however is generally impossible on account of the serious condition of the patient. To excise the whole of the affected portion, that is to say, to make one incision through the bowel above the neck of the tumour and another below the apex of the intussusceptum and to remove the entire intervening portion, is a procedure of the greatest gravity. Various other courses have been suggested and apparently the best and the one that we recommend is the operation devised by Mr. Barker, viz., local resection of the intussuscepted portion through an incision in the ensheathing layer.

Barker's operation.—The following description is from Mr. Barker's paper in the *British Medical Journal*, 1892, Vol. II., p. 1226:

> "About two inches within the anus a mass projecting into the lumen of the bowel was to be felt with the finger. This mass presented a hard, nodular irregular ring to the finger, which could be passed into the centre as into a ragged os uteri, and round the mass externally. The mucous membrane above the hard ring was apparently healthy everywhere.
>
> "Regarding the case as one of intussusception of the sigmoid flexure of the colon due to constriction of a malignant growth, I proceeded as follows. I first stretched the anus widely with the fingers until it was quite lax. The intussusception could then be drawn down until it projected four or five inches below the anus. A large silver tube was then passed up the central lumen about six inches to relieve the abdominal distension, and gave exit to a large amount of gas. Then grasping the mass with the index finger passed up the lumen of the bowel and the thumb externally I passed a stout silk stitch from without inwards, and then from within outwards through all the coats of the intussusception about one inch above the upper margin of the growth, and tied it tightly. Below this the bowel was divided transversely for a short distance. Between the serous surfaces there was no adhesion, and some glandulæ epiploicæ projected. Then a second stitch was similarly inserted to one side of the first, it being quite clear that no small intestine was seated between the serous surfaces. Then a second transverse cut was made below the second stitch. Then a third stitch and cut were made, each time the wound being examined for possible protrusion of small bowel. In this way a circle of stitches was gradually inserted all round the bowel about an inch above the limit of the growth and all the intussusception below the ring of suture was gradually cut away. Previous to suture and section the whole bowel and its surroundings had been cleansed thoroughly with warm sterilised water. No fæces escaped during the operation, and at the termination of the operation a morphine suppository was inserted in the upper part of the bowel."

It will be noticed that in this case—as in a previous successful one reported in the *Med.-Chir. Trans.*, Vol. LXX., p. 335, by the same surgeon—the intussusceptum was removed through the anus. Cases of the kind reported are rare and can clearly be safely treated in this manner, but an operation on the same lines may also be applied to the more common group of cases with which we are dealing. If a free vertical incision be made through the wall of the intussuscipiens opposite to the mesenteric attachment and extending upwards to within an inch of the neck, the intussusceptum can be drawn out through this opening and dealt with as Mr. Barker dealt with the case quoted above. There will be the great advantage in these cases that the tumour, which should be reduced as far as possible in the first instance, can be isolated and abdominal clamps can be applied so that there is little danger of soiling the peritoneum and none at all of a coil of intestine being injured between the intussusceptum and its sheath. The operation is much facilitated if a continuous Lembert suture be first of all made to unite the entering to the ensheathing layer all round the neck of the tumour. The intussuscipiens is then incised, the intussusceptum pulled out, the forefinger of the left hand thrust up its lumen to serve as a guide for the stout transfixion stitches which are to unite all the coats firmly together and which are very quickly introduced by thrusting a threaded nævus needle completely through the intussusceptum from side to side as near the neck as possible, hooking down the loop of the latter as it passes across the lumen of the bowel (after unthreading and withdrawing the needle), dividing the loop and so making two sutures, each of which traverse all the coats of the intussusceptum and the reflected layer of the sheath. A second needle is now passed in a similar manner but at right angles to the first, and then the entire intussusceptum is cut off just below the level of the sutures, which are tied and keep the two portions of bowel firmly in apposition. The vertical incision in the intussuscipiens is then closed in the usual manner (see p. 213) and the clamps removed.

When the tumour is gangrenous.—When the strangulated portion of the bowel is gangrenous the condition is very serious indeed. Here Barker's operation is inadmissible and the ideal, and indeed the only feasible, method is to excise the involved portion of the intestine and either to bring out the ends after inserting Paul's tubes (see p. 325) and make an artificial anus or, if the patient can stand it, to perform an end-to-end anastomosis.

There is another method which suggests itself and which in one case we have carried out successfully where the patient was not in a condition to stand resection of the bowel; it is to bring out the loop of bowel above the obstruction and make an artificial anus, while at the same time the intussusceptum is invaginated a little further and a continuous catgut suture is inserted through the sero-muscular coats at this newly-formed neck. This procedure is of course not very promising, but its object is, by the formation of an artificial anus, to remove one of the causes of

the patient's death, namely, obstruction and absorption of fæcal material and to give time for separation of the gangrenous intussusceptum without perforation at the neck. The artificial anus can be subsequently closed. The object of increasing the intussusception and applying the continuous catgut suture is to avoid perforation at the neck of the intussusceptum when separation takes place by obtaining union between more healthy portions of bowel. We did this in one case where the patient was almost *in extremis* and where nothing else could be thought of; in the course of a few days a large intussusceptum was passed *per rectum* and the patient recovered. It is however not a method that should be resorted to where there is any likelihood of the patient surviving a more thorough procedure.

CHRONIC INTUSSUSCEPTION.

Occasionally an intussusception occurs comparatively slowly, and for various reasons, *e.g.* excessive length of the mesentery, the constriction of the intussuscepted portion may not be as great as usual. These cases also belong to the true intermediate group between the acute and chronic forms of intestinal obstruction.

The *diagnosis* is extremely difficult and in many instances the condition is not made out until the abdomen is opened. Sometimes the symptoms are acute at first and then become chronic, but in the majority of cases they come on quite slowly and, beyond the ordinary symptoms of incomplete obstruction, the surgeon has comparatively little to guide him. Of course, should the trouble have been acute at the onset, there will be the symptoms of acute intussusception subsiding considerably and leaving signs of chronic obstruction; even here there may be a doubt as to whether the symptoms are due to a continuance of the intussusception or to adhesions left by the former trouble. The presence of a tumour can be made out in a good proportion of the cases but even this may be hard to distinguish from other abdominal swellings, particularly those found in tuberculous peritonitis. As a rule there is no continued bleeding from the intussusceptum such as gives rise to the characteristic stools in the acute form. Occasionally the diagnosis is made by feeling the apex of the intussusceptum in the rectum, or even by seeing it protruded from the anus. In many cases the abdomen will be opened because the patient suffers from chronic obstruction and the diagnosis of intussusception will only then be made.

Treatment.—Palliative.—If immediate operation be not decided upon, either because the symptoms are not urgent and the surgeon is not sure of their cause, or because the patient wishes to wait before an exploration is undertaken, *careful dieting* is very important. Only fluids,—peptonised milk, meat-juice, etc.,—should be given by the mouth and this should be reinforced by rectal feeding, except in cases of an intussusception which comes down into the rectum and is accompanied by marked tenesmus. Simple enemata may be given in order to promote the action of the bowels, but no strong

purgatives should be administered ; small doses of *salines* at the most may be given as laxatives. If there be much pain, *opium* or opium and belladonna may be used. But if the case be one of chronic intussusception the affection is not likely to subside spontaneously and operative measures should be undertaken early.

Operative.—As a rule there is no firm adhesion between the intussusceptum and the intussuscipiens and much of the invagination may frequently be undone by simple pressure. The actual apex of the intussusception, however, will not come out as a rule and either Barker's operation (see p. 339) or resection of the irreducible portion of the intussusceptum must be undertaken ; of these, Barker's operation will be the more useful as a rule.

OBSTRUCTION DUE TO ADHESIONS AFTER LAPAROTOMY.

Intestinal obstruction occurring after abdominal operations, particularly those in the pelvis, is an accident that must always be borne in mind. The cases are intermediate between the acute and chronic forms as regards the violence and rapidity of the symptoms, but really belong to the acute form as regards their pathology, and they therefore form a true intermediate group between the two. The course of events in this form of obstruction is as follows: for the first day or two the patient apparently does well, but then begins to suffer from flatulence, distension, sickness, and frequent colicky pains. At first the bowels may act and flatus may be passed, especially after the employment of enemata, but the obstruction rapidly increases and ultimately becomes complete and, unless relieved, the patient will die. The condition is usually at its worst within five or six days after the operation, but complete obstruction may sometimes be delayed somewhat longer.

The explanation of this set of phenomena is that a coil of intestine becomes adherent to the raw surface left in the abdomen and, as the parts retract, becomes pulled upon, and to some extent kinked. The result is dilatation of the bowel above with flatus, and thus the kink is increased until ultimately the obstruction becomes complete.

Treatment.—The treatment must be prompt, otherwise the patient will die worn out by the pain and vomiting and poisoned by the decomposing contents of the intestine above the obstruction.

Prophylactic.—The frequency of this accident in the early days of intra-abdominal operations, such as ovariotomy and hysterectomy, has led to various improvements in the technique designed to avoid it ; these essentially consist in the formation of peritoneal flaps which are stitched over the raw surface of the pedicle.

Palliative.—The occurrence of distension, colicky pains and vomiting after laparotomy should always engage the surgeon's most serious attention, and although it may not be necessary to re-open the abdomen on the first appearance of the symptoms, this must be done unhesitatingly and without

delay if they continue or get worse. It may happen that the kinking is not great, that the adhesion is slight, and may stretch, and that the condition may be recovered from; unless, however, improvement be evident in two or three days, it is well to operate.

Immediately the symptoms occur, *enemata* containing turpentine must be administered to promote active peristalsis, and so possibly to detach the bowel; a saline purge should also be given. No food should be given by mouth, as it increases the abdominal distension; salol in ten-grain doses may be given by the mouth with the object of diminishing decomposition of the intestinal contents. The position of the patient should be arranged so as to produce a certain amount of dragging on the attached coil; thus, when the accident occurs after a pelvic operation, the buttocks should be raised and the patient placed in a modified Trendelenburg position. Feeding should be entirely rectal (see p. 234), and opium must be rigorously avoided. Belladonna may be given, as it soothes pain and promotes peristalsis; it may be usefully combined with strychnine.

With regard to the question of early operative intervention, it is important to remember that the adhesive material is quite soft during the first few days, and that the bowel can then be easily detached; whereas if several days be allowed to elapse, organisation of the adhesions occurs and renders detachment of the bowel very difficult and accompanied by a definite risk of tearing its wall. Hence, however reluctant the surgeon may be to re-open an abdominal incision if it can possibly be avoided, he must not delay the operation too long.

Operative.—Should the symptoms increase in intensity, or should the obstruction become absolute, the surgeon must no longer delay opening the abdomen; the incision already made should be simply re-opened, while the patient is in such a position that the intestines will fall away from the site of adhesion, *e.g.* in the Trendelenburg position after pelvic operations. The edges of the wound should be widely retracted, because it is most important to see exactly what one is doing, in order to avoid tearing the softened bowel wall while detaching it. The intestines are carefully kept out of the way with abdominal cloths or Maunsell's retractor (see Fig. 66), and the former are packed round the operation area in case the bowel wall is damaged. As a rule, separation of the adherent bowel is easily effected within the first few days, but it must be done carefully and methodically; above all the gut must not be pulled upon, for it is not only adherent, but softened by the inflammatory changes, and will readily tear. The best way of effecting the separation is to press the stump to which the bowel is adherent away from the latter with the finger, and to gradually insinuate the finger through the lymph.

When the coil is detached, it should be inspected to see if it be damaged; if not, any adherent lymph is wiped away and the loop is examined to see whether a permanent kink has occurred. When the operation is done quite early this is not the case, and the bowel can be

safely replaced. When, however, a longer period has elapsed, a kink which is not rectified by detachment of the bowel may be present, and resection of this may be necessary (see p. 307). Before closing the abdominal wound all possible steps must be taken to avoid a recurrence of the obstruction, which is very likely to happen if a raw surface covered with lymph be left. If possible, therefore, the peritoneum on each side of the stump should be detached and brought over the raw surface, as ought to have been done in the first instance. The abdomen is closed, and the after-treatment is the same as for acute obstruction (see p. 327).

CHAPTER XIX.

CHRONIC INTESTINAL OBSTRUCTION.

Chronic intestinal obstruction differs considerably from the acute form in its pathology and generally also in its symptoms. It is not merely that the obstruction is in the one case rapid while in the other it is slow; it is that the pathological conditions are radically different.

CLASSIFICATION.—We may group the cases met with into two great classes:—

1. The typical form of chronic intestinal obstruction results from a gradual narrowing of the lumen of the bowel which goes on to complete occlusion. Clinically therefore two stages of the affection may be observed, namely, the period of incomplete and that of complete obstruction.

Among the *causes* of this form of obstruction may be enumerated: firstly, causes outside the lumen of the gut such as the pressure of tumours or constriction by adhesions between adjacent portions of the bowel, or between the latter and the omentum, the abdominal wall or one of the abdominal organs; secondly, various forms of stricture resulting from ulceration or from the growth of tumours in the intestinal wall; thirdly, obstruction by something in the interior of the bowel filling up its lumen, for example, a polypoid growth, an accumulation of fæces or a foreign body.

Any of these conditions may give rise to two sets of symptoms, viz.: the essentially chronic ones due to the difficulty which the bowel has in passing along its contents before the canal is completely blocked, and a more acute phase when the blockage is complete; even in the latter condition however both the symptoms and the pathology differ widely from those met with in typical acute intestinal obstruction.

2. This typical chronic intestinal obstruction may however pass into the acute form. In cancer of the sigmoid flexure, for example, the weight of the tumour and the accumulated fæcal material above may give rise to a volvulus of the sigmoid so that a true acute obstruction with all the symptoms and results already described (see Chap. XVII.) supervenes. Again, it is not uncommon for an intussusception to form when a tumour

of the bowel impedes the onward flow of the contents, the tumour forming the apex of the intussusceptum. Chronic obstruction may also be complicated by the independent occurrence of true acute obstruction, as for example when the chronic condition is due to adhesions compressing or kinking the bowel and an acute internal strangulation takes place beneath some of these adhesions. These cases do not require further consideration here; they add immensely to the diagnostic difficulties but their treatment is essentially that of acute intestinal obstruction accompanied if possible, either at the same time or later, by the treatment suitable for the cause of the chronic obstruction.

SYMPTOMS.—The various conditions enumerated on p. 345 have this feature in common, that they interfere to some degree with the passage of the intestinal contents; the lumen of the bowel becomes steadily narrower and the contents have increasing difficulty in passing on. The chief troubles of which the patient complains are constipation, colicky pains which are increased after food, and a general loss of appetite; in fact, he frequently diagnoses his own condition as one of chronic indigestion. The intensity of these early symptoms varies greatly; the patient may suffer severely so that he seeks advice comparatively early or the symptoms may attract little attention and advice is only sought when complete obstruction sets in, and even then it is often hard to get a history pointing to a previous incomplete obstruction. If asked, the patient frequently states that he was in his usual health, or that he had perhaps been a little more troubled with indigestion than usual, but that otherwise the obstruction has occurred quite acutely. But a close enquiry into what is meant by indigestion generally elicits the symptoms of interference with the passage of the intestinal contents.

After a period varying greatly in different cases and with different causes of obstruction, complete occlusion occurs; this generally arises from a mechanical cause, such as plugging of the narrow orifice by scybala or by a foreign body, but in some cases it may be due to inflammation of the intestine above the stricture. The symptoms formerly complained of increase greatly in severity. The patient becomes absolutely constipated and realises that there is a difficulty in the onward passage of the intestinal contents. He gradually becomes distended from the accumulation of gas, he begins to suffer from very acute griping pains, and finally vomiting sets in; even here it is usually quite late in the case before the vomited material becomes what is called fæcal. If the condition be unrelieved, the patient usually dies as the result of increasing weakness produced by the continued vomiting, the mechanical strain thrown upon the heart and lungs by the distension, the poisoning by the intestinal contents or from ulceration above the obstruction, followed by peritonitis or even perforation. Sometimes, however, the symptoms subside, the bowels are relieved and the patient recovers temporarily: but before long a similar attack occurs.

The patient may come under observation during the stage of either incomplete or complete obstruction; in the latter case he may be seen quite at the onset of the complete obstruction or only when moribund. The treatment will be considered from these various points of view.

CHRONIC OBSTRUCTION FROM CAUSES OUTSIDE THE BOWEL.

TUMOURS.—It is not very uncommon for the intestine to be compressed by a large tumour external to it; for example, the sigmoid flexure may be seriously pressed upon by uterine or ovarian tumours and all the symptoms of intestinal obstruction will be then produced.

Treatment.—The obvious treatment is to remove the obstructing cause if possible, but this is not always possible either because the tumour is too firmly fixed, or because the patient's condition will not allow of it As a rule the tumour is removable as it is usually a simple ovarian or uterine growth, but it may be malignant and may not merely press upon the intestine but may actually involve its wall and thus be completely irremovable. When either the tumour is inoperable or the patient is suffering from an attack of complete obstruction removal is out of the question; it is better to establish an artificial anus and, should the tumour be removable, to proceed to remove it and close the artificial anus when the patient has recovered from the effects of the obstruction.

ADHESIONS.—The other extrinsic cause of chronic intestinal obstruction is adhesions following peritonitis, usually tuberculous. The intestinal coils become matted together in the affection, the omentum becomes thickened and adherent to them and, as the case gets well, the inflammatory material contracts and may constrict the bowel and give rise to an incomplete obstruction. In addition there is often great shrinking of the mesentery so that the intestine becomes kinked, and the greater part or the whole of the small intestines may become matted together; this interferes seriously with the patient's nutrition and may even endanger his life.

Another not uncommon cause of these peritonitic adhesions is appendicitis. Not only are coils of intestine frequently matted together, but the lower end of the ileum, or more rarely the ascending colon, may be compressed by adhesions to such an extent as to seriously diminish the calibre of the bowel. Similar adhesions also occur in connection with other forms of local peritonitis such as salpingitis or perimetritis. Another very frequent seat of peritonitic adhesions is in the neighbourhood of the liver as the result of gall-stones, or that of the stomach as the result of gastric ulcer (see p. 230); in the latter case the constriction especially affects the large intestine and the stomach. Sometimes these adhesions seem to follow blows; here probably hæmorrhage has occurred and the blood-clot in organising gives rise to the obstructing adhesions. Another example is seen after the relief of a strangulated hernia in which the lymph thrown out at the line of strangulation may organise into a perma-

nent constriction; it is however more probable that this constriction is due in most instances to ulceration of the mucous membrane and not merely to external adhesions. Lastly, adhesions of this nature may form after operations on the peritoneal cavity.

In all these cases there may be actual constriction of the bowel by the adhesions, or kinking as the gut is pulled upon by them or the shrunken mesentery or, more usually, the two conditions combined. The result is a long period of incomplete obstruction often interrupted by attacks of the more complete form which usually follow the ingestion of indigestible foods. The patient often suffers much pain from the constant contraction of the intestines, the abdomen becomes somewhat distended and the hypertrophied coils of intestine may be seen moving beneath the abdominal wall, while the patient emaciates, often to an extreme degree when the small intestine is affected.

Treatment.—The treatment is often very unsatisfactory although, when the adhesions are quite limited, brilliant results may be obtained. In a good many instances the diagnosis is comparatively easy, the previous history of the case, the age of the patient and other symptoms pointing pretty clearly to the nature of the trouble. On account of its uncertain results operative treatment should not be resorted to in a hurry; not only is it often very difficult to separate the adhesions but, even when this is done, fresh ones almost invariably form very quickly.

(a) **Palliative.**—The non-operative treatment consists essentially in *careful dieting*; the chief point is to see that the patient takes highly digestible food free from solid lumps that might block the narrowed intestine. The food need not be fluid but should be finely minced, and vegetable fibres, raw salads, nuts, and so forth should be strictly avoided. It is generally necessary to employ some *laxative* to secure a regular action of the bowels, and the best for this purpose are salines in small doses, such as the various mineral waters or drachm doses of sulphate of magnesia or phosphate of soda two or three times a day. *Massage* and even *electricity* may be applied to the abdomen with the object of moving on the contents of the intestine and gradually loosening and stretching the adhesions; neither must be employed however if there be active peritonitis.

(b) **Operative.**—When the symptoms are severe, the question of laparotomy for the removal of the adhesions must be considered, and it is only right that this should be done before complete obstruction occurs. The abdominal cavity is opened in the middle line, unless there be a very distinct indication to the contrary. The position of the incision relative to the umbilicus will vary according to the indications; if they be those of adhesions towards the upper part of the abdomen, in connection with the gall-bladder for example, the opening will be above the umbilicus: if they point to adhesions in Douglas's pouch it will be as low down as possible. When there is no definite indication, the opening should be below the umbilicus, but in most cases this will have to be extended

upwards until ultimately its mid-point is the umbilicus; this is the best situation for getting access to a shortened mesentery. Great care must be taken in opening the abdomen because the intestines may be adherent to the abdominal wall; before dividing the peritoneum therefore it is well to try to ascertain whether adhesions be present and, if so, to make the opening well above or below the adherent area.

After the abdomen is opened the procedure depends essentially upon the conditions found and, as these vary enormously, it is impossible to do more than indicate the chief lines of treatment. *If the adhesions be few and limited to one portion of the intestine*, cautious division with a tenotomy knife will often suffice. We have seen this procedure successful more than once; in one case, where a narrow line of adhesions from an old appendicitis had constricted the lower end of the. ileum, the bowel resumed its natural calibre after the bands were divided and the intestinal contents passed on at once although the patient had previously been almost moribund from what was practically acute intestinal obstruction.

When the condition is due to traction on a loop of the bowel producing a kink, the latter may cease to exist when the adhesions have been divided and the lumen of the bowel is at once restored. These are exceptionally favourable cases and in them nothing further is required.

After a contracting band has been divided, fibrous tissue may be found along the groove of the kink producing a permanent constriction. An attempt should first be made to relieve this by careful notching with a tenotome; if this fails to allow the bowel to expand, the only remedy is to excise the kinked portion and to perform an end-to-end suture of the intestine. The adoption of this procedure must be determined by the condition of the patient, but it is so essential that a good deal of risk must be taken rather than leave the obstruction unrelieved. The various methods of intestinal suture have been already detailed (see p. 306).

In cases of *adhesion of the intestine to the parietal peritoneum* the simplest plan in difficult cases will be to detach the parietal peritoneum, divide it around the adhesion and leave it attached to the bowel; the adhesion is often so firm that any attempt to separate the bowel from it will lead to rupture. The parietal peritoneum should then be further separated and the raw surface left on the parietes after detachment of the bowel should be covered over by bringing together the cut edges of the peritoneum.

When a large mass of the bowel is matted together attempts may be made to separate these adhesions on the same plan; the connections between the loops may be notched with a tenotomy knife and the adherent coils then separated with the greatest care lest rupture of the intestine should occur. If the separation be successful, a large raw surface will be left on the intestine, the abdominal wall, or any other structure to which adhesion has taken place, and the probability of recurrence or of the formation of fresh adhesions is very great indeed, and practically we can-

not take any certain means to prevent this. It is important, however, to arrange the patient's position so that the raw surfaces are separated from one another as widely as possible; for example, after adhesion of the intestine to the gall-bladder the patient should sit up during convalescence, so as to carry away the raw intestine from the denuded gall-bladder, while in pelvic cases the Trendelenburg position may be maintained. Fresh adhesions will no doubt form, but they may not cause any particular discomfort. When the omentum is healthy the raw surfaces have been covered by portions of this structure, which are either completely detached or, where large surfaces have to be covered, left with sufficient attachment to retain their vascular supply; there is no doubt that omentum adheres readily, and, if healthy, may diminish the chance of subsequent adhesions.

The greatest difficulty is met with when there is very widespread matting together of the bowels. Sometimes the bulk of the small intestines form a matted mass drawn up towards the upper part of the abdomen, and the bowel is so involved that attempts to free it are out of the question; the surgeon is then face to face with a very serious problem. Two alternatives have been proposed, viz., to excise the whole mass of adherent intestines, and to follow this with end-to-end anastomosis, or to do a lateral anastomosis between healthy intestine above and below the obstructed mass. Both of these procedures are very grave, and may be quite out of the question. In very severe cases almost the whole of the small intestine is involved, and to cut it out or to shut it off from the intestinal circuit by an anastomosis will lead to the patient's death from starvation. On the other hand, when the mass, although so matted up that it cannot be separated, is quite small, and involves not more than two or three feet of small intestine, the best plan is to excise it, and to form an end-to-end anastomosis. Excision is very much better than lateral anastomosis, because in the latter a large mass of intestine is left in which the intestinal contents will accumulate and undergo decomposition; whereas end-to-end union restores the normal passage of the bowel at once. The choice between excision with end-to-end union and lateral anastomosis will be influenced mainly by the condition of the patient, and the probability of his standing the more prolonged operation involved in the resection. It must, however, be admitted that when such extensive adhesions exist, it is seldom that either plan can be adopted.

When the obstruction has become complete and the operation is done for the acute condition in these cases of adhesions, the outlook is very grave indeed. It may be that separation of some narrow contracting band over the bowel will liberate it sufficiently to permit the onward passage of the contents. It may be that there is a limited kink which separation of adhesions may free, or, on the other hand, excision of the kinked portion with end-to-end union may meet the requirements of the case. But, as a rule, when these extensive adhesions exist, it is practically

impossible to do any good by operation. Rather than allow the patient to die of the obstruction, one would naturally perform a lateral anastomosis, but this is only a temporary expedient.

OBSTRUCTION FROM CHANGES IN THE BOWEL WALL.

The most common forms of chronic obstruction fall under this heading and the stenosis may be due to non-malignant or to malignant disease. Stenosis of non-malignant origin may be either congenital or may follow ulceration of the mucous membrane. Stenosis of malignant origin is usually due to a primary growth occurring in the mucous and sub-mucous tissue and subsequently infiltrating the rest of the wall and leading to ulceration.

SIMPLE STRICTURE.—*Congenital strictures and malformations of the bowel* may occur almost anywhere along the intestinal tract but are most frequent in the rectum; they will be described in connection with affections of the rectum. The degree of stenosis met with elsewhere may vary from a complete solution of continuity between two segments of the bowel to an incomplete diaphragmatic septum. Congenital strictures of the duodenum are not uncommon and generally occur in its second part just above the entrance of the common bile duct. Another situation of congenital stricture of the intestinal canal is the ileum, usually in association with Meckel's diverticulum. Congenital strictures of the colon are very rare indeed.

These congenital conditions very seldom come under surgical treatment for the reason that, when they are serious, the symptoms become manifest immediately after birth at a time when no effectual operative procedure can be borne by the infant. Should they manifest their effects later on, the condition will only be very slight and the treatment will be analogous to that of stricture originating after birth.

Among the congenital malformations of the bowel which present themselves for treatment, almost the only one which need be mentioned is *a fæcal fistula* occurring usually from the omphalo-mesenteric duct, and here there is practically no possibility of remedying matters because the intestine below is so very narrow and badly developed that it will not carry on its functions even if an end-to-end union were made.

Stricture due to non-malignant ulceration may be brought about in a variety of ways, the chief of which is that associated with tuberculous disease of the intestine. In connection with tuberculous peritonitis we shall have to refer again to tuberculous ulceration of the intestine, but we may make a few remarks about it here.

A tuberculous ulcer is most frequently met with in the lower part of the ileum but may be present in any part of the bowel and the ulcers may be either single or multiple; the multiplicity of tuberculous ulcers should be borne in mind when operation for this form of stricture is called for, because the relief of one stricture may not cure the symptoms. The ulcer possesses the general characters of the ordinary tuberculous ulcer; it is often extensive,

it is generally elongated in shape with its long axis transverse to that of the bowel around which it may actually extend. The ulceration usually passes deeply into the sub-mucous and possibly also into the muscular coat and the contraction accompanying it may lead to great diminution in the lumen of the bowel. When the ulcer penetrates deeply, peritonitis occurs outside and the contraction of the exudation still further increases the narrowing. The affection is very often accompanied by tuberculous peritonitis (see Chap. XXI.). Curiously enough, typhoid ulcers practically never give rise to stricture. The simple duodenal ulcer also very seldom causes stricture.

Dysenteric ulcers very commonly lead to a certain amount of stricture but, as they occur in the large intestine, they comparatively seldom produce so much narrowing as to cause prominent symptoms of obstruction; when they do so, it is generally in the sigmoid flexure or towards the upper part of the rectum. *Ulcerative colitis* is a very fatal disease although it may also occasionally be the cause of constriction. *Syphilitic ulceration* leading to stricture is very rare in any part of the intestinal tract except the lower part of the rectum; this will be more appropriately referred to in connection with diseases of that organ.

MALIGNANT STRICTURE.—New growths causing stricture of the bowel are practically always malignant and belong to the class of columnar epitheliomata. In the great majority of cases the growth is primary in the bowel itself, springing from the Lieberkühnian follicles, infiltrating the sub-mucous tissue and finally penetrating to the muscular and the peritoneal coats. The wall of the bowel, however, may sometimes be involved secondarily, chiefly from direct continuity, by malignant disease of the uterus, prostate or ovaries. Malignant growths are by far the most common cause of stricture of the large intestine and after forty or fifty years of age are almost the only one. In the small intestine the case is different and there non-malignant strictures are not so uncommon; indeed according to some authors they are the commoner form.

The cylindrical epithelioma of the bowel forms a hard, raised, firm nodule projecting from the mucous surface of the intestine. This nodule soon ulcerates and the disease spreads around the bowel until a characteristic constriction is produced—a sort of diaphragm of growth across the lumen presenting towards the centre a ragged ulcerated aperture which is often very narrow. The amount of growth present in proportion to the constriction produced is very variable; sometimes the stricture is extremely tight like a ring round the bowel, while the amount of growth is very small indeed; sometimes the exact opposite is the case. The disease, like cancer elsewhere, affects the glands in the neighbourhood, in this instance in the mesentery, and leads to secondary growths, especially in the liver. It is an interesting point that growth in the glands and in the liver usually proceeds much more slowly than does the primary disease in the bowel and, when the latter has been removed, a considerable time may elapse before the secondary growths cause death—a much

longer time for example than in the ordinary cases of cancer of the breast. Sometimes the disease spreads to the peritoneal coat and then infection of the peritoneum occurs and cancerous nodules form all over it and give rise to an acute cancerous peritonitis accompanied by an effusion of fluid.

Complete obstruction will ultimately result unless the patient dies of some intercurrent affection; the closure of the lumen of the bowel may be brought about in various ways. Most commonly perhaps it results from blocking of the narrow opening by some foreign body; in other cases the obstruction is due to inflammatory swelling of the mucous membrane above the stricture. Occasionally, the tumour may cause a volvulus or an acute intussusception, but in the latter cases the symptoms are typical of acute intestinal obstruction. The intestine above the stricture becomes greatly dilated and, in the early stages at any rate, the walls become much hypertrophied; in the large intestine the longitudinal bands are greatly thickened and may be mistaken for prolongations of the disease. The mucous membrane above the stricture becomes inflamed and may ulcerate and the bowel may even become perforated.

Symptoms.—The symptoms are indistinguishable in most respects from those of non-malignant stricture which have been already detailed (see p. 346). In a malignant stricture, especially when it is low down, there is often the occasional passage of blood-stained material, and a large quantity of mucus due to the colitis above the stricture. The presence of a tumour may or may not be detected; this depends to a great extent on the situation of the disease and also to a considerable extent on the amount of growth present and the degree of abdominal distension. When there is quite a narrow constriction, no tumour can be made out from the outside and we know of a case in which the surgeon passed his finger along the whole colon from the cæcum down to the sigmoid flexure after the abdomen had been opened and failed to detect a stricture which was found in the transverse colon *post-mortem*.

The situation of these strictures varies very much. Generally it is towards the lower end of the sigmoid flexure or at the commencement of the rectum. Other favourite seats are the cæcum and the flexures of the colon.

Treatment of simple and malignant strictures.—The treatment depends upon whether the obstruction is incomplete or complete.

(a) **When the obstruction is incomplete.**—The ideal treatment is to remove the stricture whether it be simple or malignant while the patient is in a comparatively good state of health, and then to do an end-to-end anastomosis. If the existence of a tumour can be made out there must be no delay in opening the abdomen to remove the disease if possible or, if not, to do some operation that will relieve the symptoms; the earlier the diagnosis is made the greater will be the chance of removing a growth.

Resection of an intestinal stricture.—The *incision* will vary with the situation of the disease. If for instance a tumour be felt in the region of the cæcum, the ascending or the descending colon or the sigmoid flexure, a lateral incision over the seat of the disease will no doubt give most convenient access; on the other hand, when the situation of the disease is unknown or can only be guessed at from the symptoms, the abdomen must be opened in the middle line. Except in the case of the ascending and descending colon, most tumours of the intestine can be removed through a median incision.

With regard to the *excision of the stricture* there is nothing to add to what has already been said (see p 307). The end-to-end anastomosis is usually most satisfactorily done by means of Mayo Robson's bobbin (see p. 309). Murphy's buttons should be avoided except in cases of great emergency where a few minutes are of great importance, because the lumen of the bowel is likely to be unduly narrowed. In removing a tumour from the small intestine a wedge must be taken out of the mesentery and this should enclose all the enlarged glands if possible; if not they must be dissected out separately, taking care not to interfere with the blood supply of the bowel.

It is an open question whether the surgeon should excise a readily removable local growth, *e.g.* in the small intestine, when it is accompanied by a glandular infection that negatives any hope of eradicating the disease. We think most certainly however that this should be done and for three reasons. In the first place, the patient, if not actually suffering from complete obstruction, must inevitably do so before long and will need an operation for the relief of that, notwithstanding the existence of secondary growths; therefore an operation which restores the lumen of the canal while the patient's condition is good is the best thing that can be done, quite apart from the question of whether the disease is eradicated or not. In the second place, the secondary growths in the glands and the liver usually progress much more slowly than does the disease in the bowel and, apart from the comfort and prolongation of life afforded by relief of the obstruction, life may be further prolonged by removing the rapidly growing intestinal disease. Lastly, in the small intestine and also in the transverse colon and sigmoid flexure an end-to-end anastomosis is easier and more satisfactory at this stage than is a lateral anastomosis, while it saves the patient from the distress entailed by an artificial anus which otherwise sooner or later becomes imperative. At the same time this rule does not apply to the fixed portions of the large intestine; there, resection followed by end-to-end anastomosis is one of the most difficult and dangerous of all the operations upon the intestines.

The details of the operations will vary with the seat of the disease. In the case of a simple stricture of the small intestine or a freely movable malignant growth there is little difficulty. There will be the same difference in the calibre of the bowel above and below the obstruction as is

seen in acute obstruction (see p. 325); the remarks made there apply here also.

The chief difficulty in excising malignant tumours of the bowel occurs when they affect parts not completely surrounded by peritoneum or in the case of the hepatic and splenic flexures of the colon which are very difficult to get at. The difficulty in the case of the ascending and descending colon is partly due to the steps of the operation having to be carried out deep down in the loin and partly to the difficulty of securing accurate union of the posterior wall of the bowel; moreover, when the tumour is large and much of the bowel has to be removed, there may be great difficulty in the approximation of the divided ends. In some cases indeed it is impossible to approximate these satisfactorily and either a colotomy opening must be made and a Paul's tube inserted, or both the divided ends must be sewn up and a lateral anastomosis effected with some more movable part of the bowel, such as the ileum to the transverse colon in cancer of the ascending colon, or the transverse colon to the upper part of the sigmoid flexure in cancer of the descending colon. The difficulty of accurate suture mainly affects the part uncovered by peritoneum and perforation in this situation may subsequently occur; fortunately the opening generally forms outside the peritoneal cavity and, even though it ends in the formation of a small fæcal fistula, the latter subsequently closes without much trouble. We shall describe one or two of the chief operations on the large bowel.

Excision of the cæcum.—When the growth is about the cæcum and the ileo-cæcal valve, and it is found on detaching the reflection of the peritoneum from the cæcum to the abdominal wall that the tumour has not spread outside the wall of the bowel and can be removed, the line of resection will go on the one hand through the lower end of the ileum and on the other through the commencement of the ascending colon, the ileo-cæcal valve being removed together with the cæcum (see Fig. 98); this is a comparatively easy matter if the case be suitable for excision. The ileum is clamped about three inches on the proximal side of the incision, while the ascending colon on the distal side is either clamped with a suitable clamp, such as Makins' (see Fig. 65), or compressed by the fingers of an assistant. The peritoneum is then detached as it passes from the cæcum to the iliac fossa, and the bowel is stripped up, the vessels ligatured, and the entire mass removed, together with any glands in the iliac fossa.

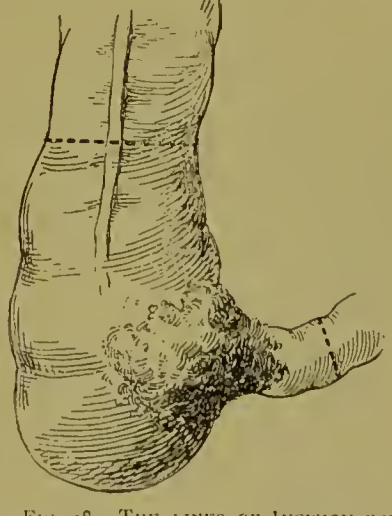


Fig. 98.—The lines of Incision for complete Excision of the Cæcum.

The important point in the operation is the restoration of the intestinal

canal. By some an end-to-end anastomosis is recommended, the open end of the ascending colon being reduced in size by sutures until it is of the same calibre as the ileum, and the two portions of the bowel being then sewn end-to end (see p. 307). End-to-end union may be employed when there is great dilatation of the ileum and corresponding collapse of the ascending colon, and when therefore the two openings are practically of the same size and can be pursed up over a Mayo Robson's bobbin; but in the majority of cases, in which the disproportion between the two portions of the bowel is considerable, and where therefore a portion of the end of the colon must be sewn up, this leaves a decidedly weak spot where the sewn-up portion of the colon joins the circular suture uniting the two portions of the bowel, and fatal perforation is apt to occur at this spot. We have had two successful cases of resection of the entire cæcum by the following method: After removal of the cæcum, a vertical incision



A *B*

FIG. 99.—FORMATION OF A NEW ILEO-CÆCAL VALVE AFTER EXCISION OF THE CÆCUM. *A* shows how the open end of the ileum is drawn through the lateral opening in the ascending colon and its sero-muscular coat stitched to the muco-muscular coat of the colon. The open end of the latter is turned up to allow of proper access. *B* shows the operation completed by invaginating and closing the open end of the colon and uniting the peritoneal coats of the ileum and the colon all around the new ileo-cæcal valve by a continuous suture.

the length of the transverse measurement of the open end of the ileum was made through the wall of the ascending colon, about an inch above its open end and as far away from the mesenteric attachment as possible. Through this the open end of the ileum was pulled so that a quarter of an inch or more projected into the interior of the colon. A double row of stitches was then employed to keep the bowel in place. The first row fastened the mucous and muscular coats of the colon to the sero-muscular coat of the ileum as it passed through the aperture. This row of stitches was readily introduced by folding back the open end of the ascending colon and thus exposing the parts to view (see Fig. 99). A second row of Lembert's sutures was then inserted through the adjacent sero-muscular surfaces of the ileum and the ascending colon from outside. In this way the small intestine was fixed into the aperture made in the ascending colon, so that its free end projected from the mucous surface much in the same way as the lips of the ileo-cæcal valve. The open end of the ascending colon was finally invaginated by a double row of stitches, the deeper one of catgut taking up all the coats of the bowel, while the superficial one invaginating the first was a sero-

muscular suture of fine silk. The free edge of the mesentery left by the removal of the portion of the ileum was stitched to the meso-colon so that no gap remained.

This operation is easy to carry out when only the cæcum and the adjacent portion of the ileum are removed. But when a considerable portion of the ascending colon has to be taken away as well, it is difficult, on account of the obliquity, to implant the lower end of the ileum into the colon as described above. The best plan then is to invaginate the open ends of both portions of bowel in the ordinary manner, and then to perform a lateral anastomosis between the two portions (see Fig. 100). Care must be taken that the peristaltic wave runs in the same direction in the ileum and the colon, for it is very easy, by twisting the former, to anastomose them so that it goes in opposite directions. This is not a matter of such great importance in this particular instance as it is in gastro-enterostomy (see p. 242), as the contents of the small intestine are quite fluid, and at most will only produce a little dilatation of the blind end of the colon; at the same time it is well to avoid it.

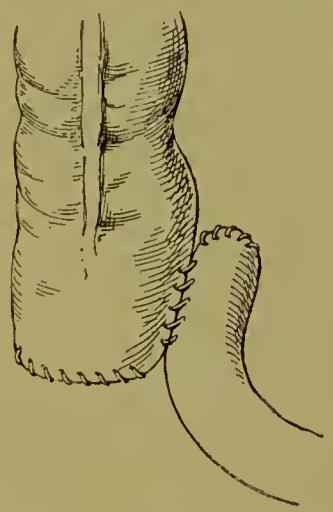


FIG. 100. — LATERAL ANASTOMOSIS BETWEEN THE ILEUM AND THE COLON. Both ends are invaginated and closed. The blind end of the ileum should be upwards, that of the colon downwards, as above.

In cancer of the splenic or hepatic flexures the tumour is often adherent to the parts in the neighbourhood — *e.g.* the hepatic flexure to the liver—and excision is impossible, the surgeon having to be content with a short-circuit operation.

Many strictures of the intestine, more especially the malignant ones, are so situated or are so extensive that excision and end-to-end union are out of the question and under the circumstances two alternative methods remain: viz., (*a*) Anastomosis of the bowel above with that below the stricture so as to enable the intestinal contents to pass without going through the strictured portion of bowel, an operation spoken of variously as a "short-circuit operation" or an "intestinal anastomosis," or (*b*) the formation of an artificial anus above the stricture.

Intestinal anastomosis.—It is clear that an intestinal anastomosis is far superior to an artificial anus and should be done wherever it is possible. The chief objection to it, and one that must be attended to in operating, is the tendency of the opening to contract, and, as in the case of gastro-enterostomy, this is most marked when the intestine above the stricture is much dilated (see p. 244). To avoid this it is important to make what may appear at the time to be an unduly free communication between the two portions of the bowel; for this reason the anastomosis is much better done by simple suture than by any form of apparatus, and this plan should always be adopted except when the patient is so ill that a few minutes is a matter of life or death.

The opening should be made on the convex border of the bowel and it is important to see that the gut is so applied that the peristaltic wave runs in the same direction in each loop. If the wave travels in one direction in the upper portion of the bowel and in the opposite in the lower, there will be difficulty in the passage of the fæces ; from the proximal loop of the gut they are driven into the upper portion of the distal loop and when that empties itself they are apt to be driven back into the proximal loop again. In the small intestine, this is not a matter of very great importance as the contents are fluid and readily run through the opening ; but in the large intestine, where the contents are more solid, much trouble may be caused.

A second point of importance in performing a short circuit operation is not to shut too much of the bowel out of the circulation lest fæces accumulate in the loop (especially in the large intestine), become dry and cause trouble ; they dilate the loop, cause pain by pressure on the stricture, and lead to inflammation and even ulceration of the mucous membrane. Hence it is well to leave as short a space between the opening and the stricture as possible. Another reason for this is the possibility of partial or even complete internal strangulation through the loop thus formed. In bringing the two portions of the intestine together there must be no stretching of the intestine and the two portions should lie easily together without kinking.

The actual steps of the short-circuit operation are the same as those already described for gastro-enterostomy and the lateral anastomosis of the intestine with the view of avoiding the vicious circle (see p. 249).

Artificial anus.—An artificial anus should only be made when intestinal anastomosis is impossible ; this is most frequently due to the situation of the disease, or its extent. In the small intestine, however, an artificial anus must never be made except in extreme cases ; even at a considerable risk to the patient a short-circuit operation should be performed if it be impossible to excise the stricture. An artificial anus in the small intestine, if high up, produces profound mal-nutrition and moreover the intestinal contents are extremely irritating and give rise to an eczematous condition of the skin of the abdomen which is most distressing to the patient.

(b) **When the obstruction is complete.**—The foregoing remarks refer to incomplete intestinal obstruction in which the patient's condition is good and there is no urgency. Unfortunately, at the present time the surgeon is more frequently called to these cases when the obstruction has become complete and the patient's condition is therefore bad. Although physicians, who generally see these cases first, are becoming more alive to the advantage of surgical treatment, they were up till recently apt to go on treating them in the vain hope that the obstruction was due to fæcal accumulation and the patient was often almost moribund before a surgeon was called in.

In complete obstruction the three chief methods of treatment are excision of the stricture, a short-circuit operation, or the formation of an artificial anus ; in connection with these procedures the question of diagnosis here assumes the highest possible importance. In incomplete cases in which

the seat of obstruction cannot be inferred by feeling a tumour, or from the symptoms, the abdomen is not acutely distended, and it does not add materially to the patient's risk to search carefully for the seat of the trouble; in the complete cases, on the contrary, the patient is not only in a very bad condition for a prolonged operation, but the abdomen is much distended, and manipulations are correspondingly more difficult and more dangerous. The immediate problem in the latter cases is not so much to rid the patient of his disease as to save his life, and, as he is dying of obstruction, the chief problem is to relieve that. The exact procedure therefore will depend on the general condition of the patient, and the amount of distension of the abdomen.

When the patient is almost moribund, it is out of the question to search the abdomen for a tumour, and an excision or even a short-circuit operation would be in the highest degree dangerous. Practically, the only thing is the formation of *an artificial anus*, and the great question is where such an opening should be formed. To open the abdomen in the middle line, to search among the enormously distended coils for the seat of stricture, and then to open the intestine above it, would most probably be fatal, and the problem is therefore to open the intestine above the stricture at once. The seat of the opening must be decided by the symptoms and the history of the case; the shape of the abdomen may also help the decision.

Distension mainly about the umbilicus, and not marked in the flanks, points rather to dilatation of the small intestine, and therefore to a stricture, either in the small intestine itself, or in the commencement of the large. On the other hand, an abdomen that is much distended towards the flanks, but flatter than in the former instance, points to an obstruction lower down in the large intestine. Irregularity in the distension may indicate at what portion of the large intestine the obstruction exists; thus great distension on the right side with comparatively little on the left, implies an obstruction higher up than the sigmoid flexure, especially if the left iliac fossa be not much affected. On the other hand, the distended colon may be traced down to the left iliac fossa, in which case the stricture is probably in the sigmoid. The fact that in the great majority of cases the disease is situated somewhere in the sigmoid flexure should always be borne in mind. Indications will also be given by the severity of the symptoms, the time of onset of vomiting indicating to some extent the height of the stricture. The previous history of the patient, and especially the occurrence of griping pains, which stop at a certain point, though not to be depended on very much, may, when taken in conjunction with the other symptoms, also give some idea as to the seat of the obstruction.

The most suitable place to open the bowel is in the sigmoid flexure, and in a certain number of cases, when the symptoms point strongly to a stricture at the upper part of the rectum, the ordinary inguinal colotomy

may be performed; if, however, the sigmoid flexure be found empty, the ascending colon must be opened. But when the seat of stricture is uncertain, and the patient is *in extremis*, it is safer to perform a right-sided colotomy rather than run the risk of having to do a second operation. Even here it is essential to be sure that the opening is on the proximal side of the stricture. We have known a case where the ascending colon was opened without relief to the symptoms, and where, *post mortem*, the stricture was found only a couple of inches above the opening.

Right inguinal colotomy.—The ascending colon may be reached either by an operation corresponding to left lumbar colotomy,—or the incision may open the peritoneal cavity, as in left inguinal colotomy. The latter operation allows the surgeon to be quite sure that he is opening a distended portion of the bowel, and he can easily pass his finger downwards along the colon and investigate the state of the cæcum and the ileo-cæcal valve. If the bowel here be above the seat of stricture,—*i.e.* is distended—the artificial opening can be made safely, and the only difficulty is the shortness or absence of the meso-colon; if, however, the incision be made a little further forward than the usual one for a right lumbar colotomy, the bowel can generally be got sufficiently into the wound to serve the purpose required, although never so satisfactorily as in left inguinal colotomy. The chief difficulty is the formation of an efficient spur, but this is not a matter of great importance as a right-sided colotomy is only a temporary measure as a rule, and therefore the less efficient the spur the better.

An incision is made obliquely downwards and forwards with its centre a little more than an inch above a point on the crest of the ilium about two inches behind the anterior superior spine, and the muscles are partly divided, but chiefly separated, the peritoneum is opened and the large intestine at once presents. The state of the intestine in the vicinity is then examined and the loop of bowel is brought as far as possible into the wound by detaching the peritoneum behind so as to free the gut sufficiently to enable its whole lumen to be brought outside the wound. To fix the loop in position and to form a suitable spur we employ one of the two following methods according to the necessities of the case. If the patient's condition be fair and if the abdominal parietes be not very fat, so that the bowel comes well up into the wound, we put in a mattress suture in the following manner. The skin having been dissected back for a little distance, a stout silk thread is passed by means of a nævus needle through the rest of the abdominal wall near one end of the incision, then through the meso-colon and finally through the abdominal wall on the opposite side. One end of the thread is caught here, pulled through and held, and the needle, still threaded, is drawn back and again made to traverse the several structures in a similar manner at the lower part of the wound (see Fig. 101); the needle is then unthreaded and withdrawn. When this suture is tied, the abdominal muscles are pressed against the sides of the bowel and the suture passing behind the latter prevents it slipping back into the abdomen and at the same time helps

to form a spur. A few catgut stitches are then inserted between the skin and the sero-muscular coat of the bowel.

When haste is essential or when the abdominal wall is so fat that there is some difficulty in getting the bowel properly to the surface, the use of

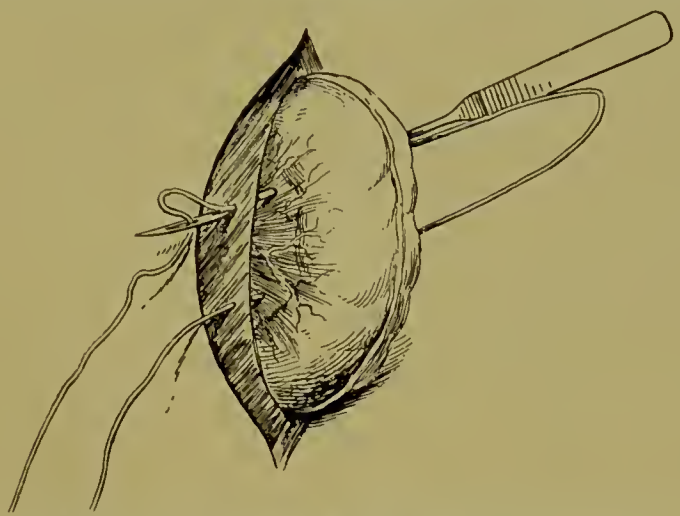


FIG. 101.—METHOD OF INSERTING THE RETAINING SUTURE IN COLOTOMY. The thread is seen passing through the muscular walls of the abdomen and through the meso-colon. It passes through the abdominal walls similarly on the other side of the incision.

mechanical supports, such as bone, ivory or metal pegs or glass rods is perhaps preferable, as they support the bowel better and make a very efficient

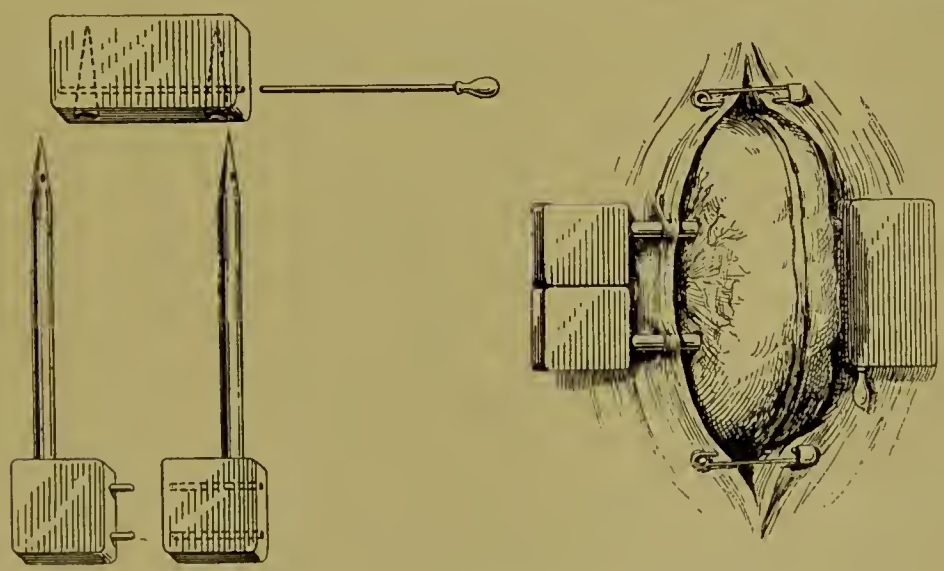


FIG. 102.—PINS FOR EXPEDITING THE OPERATION OF COLOTOMY. Each pin—which is of tempered steel with a sharp point—is thrust through the skin and muscles on one side of the wound, then through the meso-colon, and finally made to traverse the constituents of the abdominal wall in the reverse order on the opposite side. The pins are bolted together, and the bowel can then neither advance nor recede. If two safety pins be passed through the lips of the wound and the muscular coat of the bowel as shown above, no stitches at all are necessary, and the operation can be done very rapidly. The manner in which the pins are bolted together is also shown.

spur. These supports are used much in the same manner as the mattress suture, being passed through one edge of the incision in the abdominal

parietes, through the meso-colon and then through the abdominal wall on the opposite side. One or two may be employed according to the necessities of the case ; if the latter number, they should be about an inch apart. With an abdominal wound of suitable size these pegs hold the bowel immovably in position and no stitches are required. We have lately been in the habit of using specially designed metal pegs for this purpose which pass through the skin, the abdominal wall and the meso-colon and are mechanically bolted into position where they hold the bowel immovably. With these the entire operation from first to last is a matter of a few minutes only (see Fig. 102).

Finally the colon is opened and a large sized Paul's tube inserted after the line of incision has been powdered with iodoform and carefully packed all round to prevent soiling (see p. 327). The colon should not be cut across. The objection to this operation is that if the stricture be far down along the colon there will be a considerable tract of bowel between the stricture and the opening in which fæces and gas may accumulate and cause not only trouble at the time but, if the spur be inefficient, much subsequent inconvenience.

A right-sided colotomy should only be regarded as a temporary expedient and, when the patient recovers from the obstruction, the possibility of obtaining a more suitable opening, of excising the stricture or of doing an anastomosis will have to be considered. Unless there be some distinct contra-indication, the proper treatment is to open the abdomen in the middle line at a later date, to search for the obstruction and to deal with it according to the principles already laid down for chronic obstruction (see p. 353). If it be possible to excise the stricture, if an anastomosis be made or if a permanent left inguinal colotomy be eventually done, it is usually comparatively easy to close the opening on the right side as the condition is really one of a fæcal fistula and not a true artificial anus.

Left inguinal colotomy.—When the surgeon comes to the conclusion that the disease is in the lower part of the sigmoid flexure, he is warranted in doing a left inguinal colotomy even though the patient's condition be very grave. The opening should be made in the upper part of the sigmoid flexure, *i.e.* a little higher than is usual for cancer of the rectum, but the abdomen should be opened as in the ordinary operation. If the portion of the sigmoid that presents in the wound be distended, it is quite certain that the bowel has been reached above the stricture and, before proceeding further, it is well to ascertain the exact condition of the stricture, with the view to excision either immediately or later. It has happened to us and to others that, on opening the abdomen to perform a colotomy, the tumour has been found movable enough to allow it to be brought out of the wound at once and this should be done if it be possible. Sometimes it may be necessary to divide the meso-colon in order to get the tumour well out, but this adds little to the gravity of the operation. Under such circumstances the question of immediate excision of the bowel followed by end-to-end anastomosis will arise but, in the severe cases of which we are speaking, the patient is really not fit to stand this. The simplest plan is,

after bringing the loop containing the tumour outside the abdomen, to clamp the intestine above and below, clip the tumour away and rapidly insert a Paul's tube (see p. 325) into each end of the bowel. The patient thus gets rid of the tumour and has an artificial anus formed which, should he recover, may be closed later. In the great majority of cases, however, the tumour is too fixed to allow of this and the ordinary left inguinal colotomy should be done and should be followed by the insertion of a Paul's tube.

An oblique incision with its centre on the line from the anterior superior spine to the umbilicus is made about an inch and a half internal to the anterior superior spine of the ilium. The external oblique tendon is split up in the direction of the incision and, in order to avoid subsequent constriction of the bowel here, it is well also to nick it slightly transversely, but this should not be done for more than a quarter of an inch on each side. The internal oblique and transversalis muscles are now separated in the direction of their fibres with the handle of the knife, the transversalis fascia is divided, the sub-peritoneal fat is torn through and the peritoneum opened. The distended sigmoid which then presents is pulled as far out of the wound as it will conveniently come, after an examination of the tumour with the finger. A mattress suture or the pins are now put in, as for the operation on the right side (see p. 361), and the edges of the skin wound are united above and below the bowel, the stitch nearest the latter taking up the sero-muscular coat in its transit. The skin is stitched to the meso-colon in the interval between these. A Paul's tube is now inserted in the upper part of the bowel in the usual manner and the operation is completed. The tube usually sloughs out in about three days but by that time the adhesion of the intestine to the sides of the wound is generally satisfactory. In about a week the intestine should be cut off flush with the skin or nearly so, so as to leave two openings, one above and one below. This, and the subsequent treatment of the colotomy wound will be considered more fully in connection with cancer of the rectum.

Here, as in the right-sided colotomy, the operation is primarily done to save life, but, according to what is found at the time, the decision will be made as to whether anything further can be done to remove the disease. If so, the abdomen may be opened in the middle line when the patient has recovered from the acute attack and removal of the growth practised on the usual lines. It will be well however to still leave the repair of the colotomy opening until union in the resected bowel is satisfactory. Should it be evident at the time of the original laparotomy that a subsequent resection of this kind is feasible, it is well only to draw enough of the sigmoid into the abdominal incision to allow the Paul's tube to be inserted. It is not even necessary to make a complete spur, as the second operation will be done as soon as the effects of the obstruction are recovered from and a small lateral opening into the bowel is much easier to close than a complete transverse division. It is also well to make the artificial anus well above the growth so as to give plenty of room for the subsequent resection and end to-end anastomosis.

If the patient's condition be good, the proper treatment is a median laparotomy in order to ascertain the seat and nature of the obstruction. All the preliminaries will be the same as for the acute form of the affection (see p. 320). The incision should run downwards for about four inches from the umbilicus and can be subsequently enlarged as desired. The search for the obstruction must be made in a methodical manner. In the first place the cæcum is felt for and its condition will at once give valuable information as to the seat of the obstruction; if it be dilated, the obstruction must be between it and the anus; if collapsed, the small intestine must be the seat of the trouble. At the same time also the condition of the appendix, often a doubtful point in obscure abdominal cases, can be ascertained. If the cæcum be found dilated, it is quite easy to slip the hand from the right side over to the left and find out if the sigmoid flexure be similarly affected and, as this is the commonest situation of a malignant stricture, one may at once light on the disease; if it be collapsed, the obstruction must be somewhere between it and the cæcum, and it will be advisable to extend the incision above the umbilicus so as to get good access. The ascending colon is then traced from the cæcum up to the hepatic flexure, then the transverse colon to the splenic flexure and finally the descending colon; in this way the stricture will be identified with the least possible waste of time.

Should the cæcum not be found dilated, it will then be necessary to examine the coils of the small intestine, and this is most satisfactorily done by beginning at the cæcum, hooking up the ileo-cæcal valve and passing the small intestine through the fingers from below upwards; as each coil is done with, it should be carefully packed into the abdomen and kept in place by abdominal cloths.

When the obstruction is found, it is, if possible, brought into view outside the abdomen; if this be impossible, the surgeon can ascertain by careful palpation whether it is better to enlarge the existing incision or to make a fresh one in order to examine it more accurately; this should not be done unless it seems possible to excise the tumour. The question of excising the tumour will be decided not only by the anatomical conditions but by the condition of the patient; when definite obstruction has set in it is more often than not inadvisable to proceed to such a severe operation as excision. If it be found that the tumour could be removed but that the patient would probably succumb if the operation were done immediately, a short-circuit should be established if the situation of the growth allows of it and the tumour excised later. If, on the other hand, removal of the disease be out of the question, a short-circuit operation should be done if possible if the patient can stand it, as it leaves him without the disability of an artificial anus, which however must be had recourse to if a short-circuit be impossible owing to the situation of the obstruction; in the small intestine short-circuiting, as has been already said, is the only possible procedure. It in no way interferes with subsequent excision of the stricture: in fact, it

renders that procedure a simple excision of the stricture followed by invagination of the open ends of the bowel on each side.

OBSTRUCTION FROM CAUSES IN THE INTERIOR OF THE BOWEL.

FOREIGN BODIES may be introduced into the alimentary canal intentionally or unintentionally; the most frequent subjects of this form of obstruction are lunatics and those who swallow objects for the purpose of gaining a livelihood. The various substances that have acted in this way are too numerous to mention; among them are spoons, forks, marbles, stones, fragments of glass, toothplates, etc. As a rule the dangers attaching to foreign bodies are chiefly from their liability to perforate the intestine rather than from actual obstruction, and this especially applies to those furnished with sharp points or edges. Foreign bodies are usually impacted in the narrower parts of the bowel, such as the ileo-cæcal valve.

ENTEROLITHS are usually found in the rectum and they may reach an enormous size and may be very hard; they are also met with in the cæcum. Their nuclei may be composed of portions of food such as the shells of nuts or cherry-stones and, in addition, they generally contain salts of lime and magnesia.

GALL-STONES.—Intestinal obstruction by gall-stones, although rare, is well known. A gall-stone that can pass into the bowel through the common duct can hardly be large enough to cause intestinal obstruction, and it is probable that those sufficiently large to do this find their way by ulceration from the gall bladder into the duodenum. These stones do not occlude the intestine by reason of their large size. What usually happens is that spasm of the intestine occurs below the stone and the latter lies on the top of this contraction and completes the closure of the intestinal lumen. After death the stone in these cases is often found lying quite loose in the bowel. The two principal situations in which obstruction from this cause occurs are in the duodenum itself or at the ileo-cæcal valve.

These foreign bodies give rise to a form of obstruction which is often more or less acute, with such symptoms as griping pains in the abdomen, tenderness and perhaps sickness. The foreign body gives rise to inflammation of the bowel in which it lies and dilatation occurs above as in other forms of obstruction. A correct diagnosis is seldom made although sometimes a gall-stone is diagnosed by the symptoms, the previous occurrence of bad attacks of biliary colic and the presence of a tender swelling.[1] The X-rays are of no use in the diagnosis.

[1] In showing gall-stones removed from the intestine during life at the Pathological Society on Jan. 7th, 1902, Mr. Barnard said that he had been able to diagnose the condition in two cases by the following symptoms: intense pain in the gall-bladder region, violent vomiting, disappearance of the pain from the region of the gall-bladder, and its reappearance after a few hours in the umbilical region somewhat less severe than before and accompanied by less marked vomiting: no complete constipation.

POLYPI.—Intestinal polypi may also give rise to incomplete obstruction; they very rarely cause complete occlusion. They are commonly adenomata, though sometimes they may be fibromata, fibro-myomata, lipomata or cysts. They usually have a narrow pedicle of mucous and sub-mucous tissue. They give rise to bleeding and excessive secretion of mucus, and may be mistaken for malignant tumours; they are not infrequently multiple.

Treatment—Of foreign bodies.—This consists in the removal of the foreign body. When it is impacted in the small intestine this may be done by a median laparotomy from the umbilicus downwards. When the abdomen is opened the seat of the impaction will be sought for as in chronic obstruction (see p. 364), and the affected portion of the intestine should be pulled out of the wound, clamped above and below, opened and the foreign body removed. It is well to open the intestine above and not immediately over the foreign body, as the wall of the bowel in the latter situation is usually inflamed and sutures may not hold satisfactorily in it, while it is generally easy to extract the foreign body from above either whole or piecemeal. The incision in the bowel is closed in the usual way; as a rule a single continuous Lembert suture suffices.

Of polypi.—The loop of bowel affected is brought out of the wound, clamped above and below and the wall divided over the tumour; after transfixing the pedicle by a double ligature the growth is snipped off. The closure of the intestine is carried out in the usual way by a line of continuous Lembert suture (see p. 213). In the very rare cases where the tumour is sessile it may be necessary to excise the portion of the intestinal wall.

FÆCAL IMPACTION.—One of the most important conditions that gives rise to chronic intestinal obstruction is fæcal accumulation or fæcal impaction. Patients who suffer from this affection are generally the subjects of long-continued constipation and a peculiar sluggish condition of the alimentary canal accompanied by the formation of indurated fæcal masses. The impaction may occur in any part of the large intestine. Usually the fæcal masses are in the rectum when of course the diagnosis is quite clear; this subject will be considered in connection with the rectum. Above the rectum, impaction most frequently occurs in the cæcum and about the flexures where a definite tumour may form; sometimes the whole of the colon may be one mass of indurated fæces. The process is a gradual one and there is generally no sudden and complete obstruction such as takes place in connection with a tumour. Besides the symptoms of obstruction the patient often suffers from a spurious diarrhœa which is due to the formation of a quantity of mucus consequent on colitis. The patient suffers in health, becoming emaciated and pasty in colour from the absorption of the fæcal material.

The diagnosis is very important because the mistake generally made is to confound an organic stricture with this condition and this leads to delay in calling in surgical intervention in cases urgently requiring it. As a matter of fact fæcal accumulation leading to complete intestinal obstruction is rare and, in an oldish patient, it certainly is not the first thing that ought to be thought

of: whereas unfortunately it generally is. Besides this, the onset of the symptoms is usually less severe and less sudden than where a strictured portion of the intestine has become blocked.

Treatment.—The chief reliance must be placed on *enemata* of simple soap and water or plain hot water which should rather take the form of irrigation of the bowel than of an ordinary enema. For this purpose a double tube is often used so that the water can escape freely. An india-rubber tube six inches long is introduced three or four inches up the rectum and the anus is carefully packed round to prevent the escape of the fluid beside it. The buttocks are elevated on a pillow, and a large quantity of fluid, sometimes many gallons, is run into the intestine by means of a funnel. If the fluid be hindered from running away at once it will gravitate upwards into the colon and reach the lower end of the fæcal mass and frequent repetition of these douches will ultimately soften and bring the masses away. The irrigations may be employed three or four times a day for a quarter of an hour or longer at a time. Once or twice a day an ordinary enema containing about a drachm of turpentine may be administered. The long tube usually employed in these cases has no particular advantage and in unskilful hands is actually dangerous; it is practically impossible to introduce it into the sigmoid flexure and attempts to do so may seriously injure the wall of the bowel.

Perhaps the most efficient agent in moving on these fæcal masses is the *Faradic current.* One electrode is introduced into the rectum while the other is applied over the fæcal mass and a current mild enough not to cause pain is employed. Some surgeons strongly urge the employment of the Faradic current at the very beginning of the case as a means of diagnosis, holding that, if it fails to dislodge the mass, the case is one of stricture and not fæcal accumulation. At any rate, when the mass has been softened by the irrigation and the administration of small doses of salines by the mouth for a day or two, the current should be employed, and if it fail the question of operative interference must be seriously considered. Operative procedures for true fæcal accumulation are practically never called for. No doubt it is possible to force on the fæcal mass by grasping the colon through an abdominal incision, but prolonged irrigation and electricity will effect the purpose with less risk, and operative interference is only justifiable when these measures fail and the diagnosis has become so doubtful that it is necessary to ascertain whether there be an organic stricture or not.

The *drugs* most useful are those that give rise to increased exudation of fluid into the intestine without any sudden violent purgative action and which increase its peristaltic power. Of the former class salines, such as phosphate of soda in drachm doses every four hours, sulphate of magnesia in drachm doses night and morning or small doses of the various mineral waters are the best; not until there are signs that the accumulated materials are softening and tending to move onward should more violent purgatives, such as calomel, or castor oil be administered. When this is happening, purgatives will be very useful in facilitating the discharge of the material. Of the drugs which

increase the peristaltic power of the intestine, belladonna and strychnine are the best. Strychnine may be administered subcutaneously (one-sixtieth of a grain three or four times a day). Belladonna may be given in a pill combined with a little rhubarb and nux vomica, as in the following prescription:

℞ Pulv. Rhei., - - - - - - - gr. i.
Ext. Belladonn. virid., - - - - - gr. ¼.
Ext. Nucis Vom., - - - - - - gr. ½.
Misce. Ft. pil. t.d.s.

Salol in ten-grain cachets three times a day may be employed to diminish the decomposition of the intestinal contents and thus to lessen the poisoning of the patient.

CHAPTER XX.

INFLAMMATORY AFFECTIONS OF THE INTESTINES.

The inflammatory affections of the intestine of special surgical interest are those accompanied by peritonitis; of these the chief are appendicitis, intestinal perforations and the tuberculous affections of the intestine. The most important and frequent of these is appendicitis.

The inflammatory affections of the intestinal mucous membrane do not often come under the surgeon's care; we have already dealt with duodenal ulcer in connection with ulcer of the stomach (see Chap. XIV.), and tuberculous ulceration of the intestine has been referred to (see p. 351) and will again be dealt with in connection with tuberculous peritonitis (see Chap. XXI.). Apart from the production of intestinal obstruction, tuberculous peritonitis or perforation, this form of intestinal ulceration does not come within the range of surgery except when situated low down in the rectum.

PERFORATION OF THE INTESTINE DURING TYPHOID FEVER.

Perforation is not uncommon in typhoid fever and of late years attempts have been made to prevent by operation the fatal peritonitis which must otherwise result, and in a certain number of cases the attempt has been successful; indeed we may look upon operation as a legitimate procedure, provided the condition be seen and recognised early. There is however always a certain difficulty in diagnosing the perforation and it is possible that when the fæcal extravasation is very slight the condition passes unrecognised and recovery may take place. In typical cases the symptoms are similar to those of perforation due to other causes, and are chiefly sudden shock, intense pain and violent vomiting. In some cases the patient's previous condition has been so bad and the shock is so profound that it is clearly impossible to intervene; but when the case is seen within a few hours after the occurrence of the perforation and the general condition is fairly good, the abdomen should be opened in the middle line, any extravasated material cleaned away, as for rupture of the intestine (see p. 303), and the lower end of the ileum examined for perforation. This is usually found readily and an attempt

should be made to close it. Sometimes a few Lembert's sutures will suffice; when the edges of the opening are extremely thin it may be necessary to cut away the margins of the ulcer and this should be done in such a way as to make the long axis of the incision parallel to that of the intestine. The opening is closed by a row of Lembert's sutures. The patient is always too feeble to permit of excision of the affected portion of the intestine; moreover, the typhoid ulceration elsewhere would preclude such a procedure. If the case be seen early, the extravasation is quite limited and there is no need to resort to irrigation of the abdomen; sponging will suffice, after which a small drain should be inserted down to the seat of the perforation. In cases of localised perforation suppuration has occasionally occurred and a local abscess has formed; under these circumstances the abscess should be incised and drained in the usual way.

DYSENTERIC ULCERATION.

In a few cases of acute dysentery, when the patients were going steadily downhill, attempts have been made to give rest to the bowel and so to enable recovery to take place by opening the intestine above the seat of the inflammation. In the chronic form this is generally recognised as a suitable method of promoting healing of the ulceration, quite apart from the question of subsequent constriction. We have ourselves operated once for acute dysentery and several times in the chronic form with the most successful results. We open the ascending colon just beyond the cæcum and keep the opening patent for some months, especially in the chronic cases, so as to allow the ulceration to heal thoroughly. When this has happened, the opening should be closed. It has been suggested to open the lower end of the ileum or the cæcum. With regard to opening the lower end of the ileum it may be said that, while no doubt the subsequent closure of the artificial anus is more easily carried out, a great objection to an artificial anus in this situation is that the fæcal material is often excessively irritating and leads to an eczematous condition of the skin, and thus it is impossible to keep the opening patent long enough. In the cæcum it is almost impossible to get any sort of spur and hence one of the reasons for opening the intestine, namely, the diversion of the flow of fæces, is entirely defeated; moreover, here also the contents are sometimes irritating and lead to the same skin troubles. It is for these reasons that we open the ascending colon at its commencement, which after all is usually above the seat of the inflammation. The opening, though more difficult to close subsequently than a small intestine fistula, gives a fairly efficient, though not a perfect, spur. The operation is the same as that already described for right colotomy (see p. 360) and should be done through the peritoneum and not behind it.

The remarkable thing in our cases, and it has been noted by others, is that the trouble ceased as soon as the intestine was brought out of the wound and before it was opened. In fact we have left the intestine unopened for

several days and yet, from the time that the loop of bowel was brought out, the tenesmus and diarrhœa ceased. The same has been our experience in the case of membranous colitis. What the explanation of this may be or whether it is a fairly constant phenomena we are quite unable to say.

An additional reason for opening the intestine in these cases, apart from the rest given to the lower part of the bowel by the diversion of the fæcal material, is that the entire large intestine from the cæcum to the anus may be irrigated with suitable antiseptic and astringent solutions. Boracic lotion may be employed or mild astringents, such as weak nitrate of silver (gr. i to the oz.). The irrigation, repeated once or twice daily, may be readily done by introducing a soft india-rubber tube through the distal end of the artificial opening and gradually filling up the large intestine with the solution. The escape of the fluid is provided for by a large-sized tube introduced through the anus.

COLITIS.

Acute ulcerative colitis, although rare, is unfortunately extremely fatal and, although we have not actually had the opportunity of performing colotomy here, it seems to us highly desirable to do so.

Membranous colitis is often extremely troublesome and we have in one instance performed a right-sided colotomy with marked benefit. The condition improved immediately after the operation and in six months' time the colotomy wound was closed and the patient remained quite well for a considerable period and at the present time, between three and four years after the operation, the affection is quite under control, although the patient occasionally passes membranous shreds.

APPENDICITIS.

The question whether typhlitis or perityphlitis exists apart from appendicitis is still discussed, but there is no doubt that the diseases formerly classed as typhlitis and perityphlitis were really cases of appendicitis and, although possibly a localised typhlitis or perityphlitis may occur from stercoral or other forms of ulceration, the condition must be so rare, judging by the results of operative work, that it needs no consideration.

ANATOMY.—The vermiform appendix is a rudimentary organ which represents the large cæcum in herbivorous animals but which apparently performs no essential function in the human body. It springs from the postero-internal aspect of the cæcum a little below the ileo-cæcal junction and is readily found by tracing down the anterior longitudinal muscular band of the large intestine. The root of the appendix is fairly constant in situation and corresponds on the abdominal wall to the spot known clinically as "MacBurney's point"; this is at the junction of the outer and middle thirds of a line drawn from the umbilicus to the anterior superior iliac spine. The process is usually from three to four inches long in adults; it may however

be considerably longer and is always provided with a meso-appendix containing its vessels. The tip of the appendix usually hangs free, and its position varies considerably; in the majority of cases it runs downwards and to the inner side of the cæcum; in some however it lies behind this structure and the ascending colon, while in others again it hangs down over the pelvic brim and is not infrequently found in Douglas's pouch or even adherent to the rectum. The appendix is practically always intra-peritoneal; it has been asserted that the peritoneum may be so arranged that the sub-peritoneal tissue in the outer part of the iliac fossa becomes directly involved in inflammation and perforation of the process, but this is very doubtful.

The appendix consists of mucous, sub-mucous, muscular and peritoneal coats. The first two are rich in lymphoid tissue, and the mucous surface is lined with cylindrical epithelium arranged as in Lieberkühn's follicles; apparently a free secretion of mucus takes place when there is any inflammatory condition. At the junction of the appendix with the cæcum there is a valve, and a much debated point is how far fæcal matter can penetrate into the appendix and how far it does so under normal conditions. It has been said that the concretions so frequently found in the appendix are really formed in the cæcum and find their way thence into the appendix, while others assert that these bodies actually form in the appendix itself; certainly a material apparently fœcal is not infrequently found in the appendix, but it seems most probable that the concretions are really formed in the latter by the deposit of lime salts either on portions of hardened mucus or possibly on fæcal material which has got into the tube.

PATHOLOGY.—A great variety of pathological conditions may be met with. Thus, in the common condition termed **catarrhal appendicitis** the mucous membrane is inflamed and somewhat thickened and there is increased secretion of mucus but no extension of the inflammation to the other coats. The causes of this condition are not at all clear. It is generally attributed to errors in diet, whilst some look upon it as of rheumatic origin not unlike some cases of tonsillitis. True catarrhal appendicitis usually runs a short and favourable course and may not recur. Similar causes to those which led to the attack may however give rise to a recurrence of the trouble and ultimately changes may occur in the mucous membrane which will establish a typical relapsing appendicitis.

Another not uncommon form is **obliterative appendicitis.** This is essentially a relapsing form of appendicitis and ends in destruction of the mucous membrane and obliteration of the lumen of the process. The chief danger in these cases is that the obliteration of the appendix may not proceed uniformly from the tip onwards but may commence near the root of the process leaving a tract of unobliterated mucous membrane which may become inflamed and which, if infected with pyogenic organisms, may lead to a grave form of appendicitis.

Stricture of the appendix may be met with, usually about three-quarters of an inch from the valve. This prevents the escape of secretions and very

serious results may follow if bacteria find their way into the appendix beyond the stricture. The stricture may be due to obliterative appendicitis, but it is not uncommonly caused by adhesions outside the process, or still more frequently by the kinking of an appendix which is more or less rigid from inflammation of all its coats; the kinking is rendered permanent by a certain amount of peritonitic adhesion. This condition gives rise to recurrent attacks of appendicitis, and the part beyond the kink or stricture may become infected at any time; there will then be suppuration in that portion with possibly gangrene and perforation.

Foreign bodies or concretions are also met with in the appendix. Foreign bodies entering from the intestines are comparatively rare, and as a rule those met with are concretions formed in the interior of the canal. They are usually found near the apex and, as they increase in size, they act as irritants and may lead to ulceration of the mucous membrane and extension of the inflammation to the peritoneum or to perforation.

The most serious condition of all is **gangrene of the appendix**, and there is a definite group of cases termed "*fulminating appendicitis*" in which gangrene of a considerable portion or sometimes of the whole appendix occurs rapidly. The gangrene is no doubt due to a blockage of the vessels interfering with the blood-supply to the process, or the condition may be in the first instance a bacteric infection in the cavity of the appendix leading to a thrombosis of the veins in the meso-appendix and consequent gangrene of the process. Gangrenous appendicitis is very fatal, death sometimes occurring in a few hours.

COMPLICATIONS.—The further results of appendicitis are the occurrence of localised abscesses around the appendix, diffuse suppurative peritonitis, or thrombosis and portal pyæmia or pylephlebitis.

CLINICAL CLASSIFICATION.—The cases met with clinically may be classified as follows:—1, Catarrhal appendicitis; 2, Cases depending on more permanent changes in the appendix and usually taking the form of: 3, Relapsing appendicitis without suppuration; 4, Suppurative appendicitis; and 5, Fulminating and perforating appendicitis. It must not however be supposed that it is easy to distinguish between these various forms during an attack. The diagnosis of acute appendicitis is usually easy enough, but the decision as to the form of the disease and the course that it will run is very far from easy. We shall first sketch out the typical course of each form and we shall afterwards deal with the subject from the point of view of the appearances met with in the individual cases.

1. **Catarrhal appendicitis.**—The attack varies in severity, but only those in which the symptoms are quite slight can be classed as purely catarrhal. Any symptom pointing to invasion of the peritoneum at once removes the case from the category of a mere catarrhal appendicitis. As a rule the attack commences acutely; the patient is suddenly seized with pain in the abdomen of a griping character, most marked about the umbilicus, and usually there is vomiting after the pain has lasted a short time. The

pain soon changes its character and situation, the colic passing off and leaving a more constant burning pain in the right iliac fossa, where there is generally considerable tenderness on pressure. There is some slight rigidity of the abdominal wall and there may be a little distension and some constipation. The temperature may run up to 102° or 103° F. The duration of the attack is comparatively short; the temperature usually begins to fall within twenty-four hours and the attack passes off in two or three days leaving possibly a little tenderness in the iliac region. It is probable that catarrhal appendicitis is, as many physicians assert, quite common; indeed the symptoms may be much less marked than those we have mentioned. There may be no vomiting and merely a little uneasiness in the side, so that the symptoms are often put down by the patient to indigestion. By surgeons however this form is rarely met with; in the cases to which they are called there are usually much more severe changes found in the appendix on operation.

2. Appendicitis with local peritonitis.—We are strongly inclined to regard any case with severer symptoms than those above described as indicating some graver pathological change than a mere catarrh of the mucous membrane. In the purely catarrhal cases there may be no recurrence of the trouble, or at some later period there may be other similar attacks, but the occurrence of repeated attacks generally indicate more extensive changes than those occurring in a mere catarrh, and in that case the attacks may become increasingly severe and accompanied by grave changes in the appendix.

The commencement of this form of the disease is sudden and is marked by a feeling of illness, severe colic referred to the epigastrium, and vomiting. The latter is usually only an initial symptom and ceases when the stomach has been emptied. In a few hours the pain becomes distinctly located in the right iliac fossa. The temperature rises to 102° or 103° F. and there is rigidity of the abdomen, constipation, some distension and all the symptoms of acute inflammatory fever. The rigidity of the abdomen is usually most marked on, and sometimes entirely limited to the right side, but in the early or in the late stages it may be diffused over the abdomen. In 24 to 48 hours there is generally dulness in the region of the appendix. The pain is most marked about MacBurney's point and, if the abdominal rigidity can be overcome, a fulness can often be made out in the iliac fossa.

The whole set of symptoms points to a serious appendicitis with extension of the inflammation to the peritoneal surface both of the process itself and of the intestine in the vicinity; were the parts exposed, the appendix and the various coils of intestine around it would be found glued together by lymph. These symptoms generally indicate inflammation in connection with a calculus in the appendix or with a kink or stricture; they may however indicate an actual perforation, although the symptoms are then usually more severe. The condition may end in resolution or may go on to suppuration; the latter cases are dealt with separately (*vide infra*).

When resolution occurs, the temperature begins to fall about the second day and generally reaches the normal at the end of a week, and there it should remain if no suppuration has occurred. The rigidity of the abdomen soon diminishes and the fulness, which is not a hard swelling as it is when suppuration is occurring, gradually decreases; in an ordinary attack the patient ought to be almost well at the end of two or three weeks.

3. Relapsing appendicitis.—These cases however are very prone to relapse and the relapse may occur either after a long interval of complete health or the patient may hardly have recovered from one attack before another occurs. These relapses indicate the presence of some of the permanent changes to which we have already referred (see p. 372). Early and frequent relapses usually indicate the presence of a concretion or inflammation and ulceration of the mucous membrane beyond a kink or stricture. When long intervals occur between the attacks obliterative appendicitis is more usually found; this however may be complicated with distension and inflammation of the process beyond the stricture.

In some cases the symptoms are not so acute but the relapses are very frequent. The pain is then often of a very acute colicky character lasting a few hours, but not accompanied by any marked swelling, any distinct peritonitis or much fever; the patient may be confined to bed for weeks with recurrent attacks of this pain every two or three days. This condition is termed "*appendicular colic*" and often indicates a concretion or a stricture with distension of the appendix beyond. At any time this appendicular colic may pass into the more serious acute appendicitis.

4. Acute suppurative appendicitis.—Suppuration may occur with or without perforation of the appendix. The latter group of cases must be kept distinct from the gangrenous form; in them suppuration is not the initial occurrence but takes place after a period of peritonitis giving rise to a matting of the intestines around the appendix, which is thus shut off from the general peritoneal cavity. Suppuration without perforation is quite common. The pus generally contains the bacillus coli communis and pyogenic cocci, and it is not certain which of these is the most active agent in producing the suppuration. When suppuration occurs without perforation the pyogenic cocci are probably the main agents, while in a localised peritonitis without suppuration we may assume that the main bacterium at work is the bacillus coli communis.

The symptoms vary very much in severity. As a rule they commence quite acutely and present all the symptoms of acute appendicitis (*vide supra*). There is often a rigor at the onset, although this is not essential, nor does it necessarily indicate suppuration; it is always however a suspicious feature. After two or three days the patient, instead of improving, as he should do were the case of the non-suppurative form, continues ill, the temperature remains high, the tenderness increases not only in severity but in extent, the rigidity on the right side becomes practically absolute, and a distinct lump,

more or less hard in character, can be felt. This lump may be dull on percussion, but it may sometimes be quite tympanitic from development of gas in the abscess cavity. In the great majority of cases we may assume that, if the acute symptoms last for five days without improvement, suppuration has occurred, and the absence of general peritonitic symptoms implies that this is taking the form of a localised abscess. Some authorities put the duration of these severe symptoms at an even shorter period, and no doubt in young children suppuration occurs more rapidly than in adults. In some cases suppuration only sets in after the third or fourth day and then very often marks the occurrence of a perforation; fortunately the appendix is by that time shut off and only a localised abscess develops. An increase in the severity of the symptoms and the onset of suppuration is very often apparently induced by injudicious attempts to obtain an action of the bowels. The patient is prone to attribute his troubles to constipation and either he or his medical attendant attempt to overcome this by strong purgatives; there is nothing more calculated to convert a simple into a suppurative appendicitis.

It must not however be supposed that when the symptoms are less severe suppuration will not occur. It is not at all uncommon for the symptoms to improve after the second or third day and for the temperature to fall almost to normal, and then to become irregular; the occurrence of an irregular temperature several days after the commencement of an acute appendicitis which has temporarily improved almost always indicates suppuration, and this is rendered more certain if the swelling in the iliac fossa persists or increases in size. In several cases we have found pus around an appendix when the symptoms, with the exception of the swelling, had completely subsided, so that the occurrence of suppuration is not at all easy to diagnose. The three chief points are persistence of the acute symptoms after the fourth day, the development of an irregular temperature after subsidence of the acute symptoms and a persistent swelling after the acute symptoms have passed off.

The situation and further course of the abscess vary widely in different cases. As a matter of fact, when the pus is shut off by adhesions, it is only comparatively rarely that rupture of the abscess wall, followed by a general peritonitis, occurs; but when there have been injudicious manipulations, or when the bowels have been much irritated with strong cathartics, such an accident may happen. In the great majority of cases, however, an abscess once formed remains localised, although it increases in size with varying rapidity. The situation of the pus varies according to the position of the appendix and the part involved. Perhaps the most common situation is towards the outer side of the right iliac fossa. Sometimes the abscess develops in the true pelvis, presumably in connection with suppuration near the end of a long appendix hanging down over the pelvic brim. Here a large abscess may form in Douglas's pouch leading to a matting together of the various pelvic organs: if left, it extends to the left side of the abdomen

and the pus may reach the left iliac fossa. In other cases the appendix and the abscess may lie behind the colon, in which case the swelling occurs in the loin, and the pus travels up along the colon and may accumulate between the liver and the diaphragm behind, forming a sub-phrenic abscess, or it may make its way through the diaphragm into the pleural cavity and form an empyema. Another not uncommon direction in which the pus may travel is towards the umbilicus; a sinus at the umbilicus generally indicates an old appendicitic abscess.

If left alone, the abscess gradually increases in size, although there is some evidence that occasionally the pus dries up and disappears; it generally finds its way either through a cutaneous or a mucous surface. An abscess on the inner side of the cæcum gradually extends to the abdominal wall and the pus makes its way out through the umbilicus. When the pus is well to the outer side of the iliac fossa, it may find its way out among the muscles above or below Poupart's ligament.

Most frequently, however, the pus, if left alone, perforates either the intestine or the bladder. When the suppuration occurs in Douglas's pouch it is not at all uncommon for the pus to escape through the rectum; in other cases it escapes through the cæcum or the small intestine. In the latter case fæcal matter also escapes into the abscess and thus keeps up the inflammation; ultimately the suppuration may spread to the skin and a sinus will form giving exit to gas and fæcal matter—a typical fæcal fistula. A fæcal fistula does not form so readily when the suppuration is in Douglas's pouch, and in any case the abscess cavity closes fairly readily. Much more rarely the appendix becomes adherent to the base of the bladder into which the pus may find its way.

Unless these abscesses be opened, the patient gradually wastes and goes downhill, even when no general peritonitis occurs, and may die of exhaustion before the pus has made its way to the surface; even when a neglected abscess of this kind is opened the patient may be in such an exhausted condition that he is unable to recover. Or again, when an abscess has been allowed to last for a long time, the opening may not suffice for proper drainage, pus extends along narrow channels in various directions amongst the intestines, and thus the suppuration may persist and a fresh abscess may form.

5. Fulminating and perforating appendicitis.—These are the gravest forms of appendicitis, and in them two distinct events may happen: a perforation of the appendix may occur suddenly, the first symptoms being coincident with the onset of the perforation, or there may be a complete and rapid gangrene of the whole appendix; the latter is the typical form of "*fulminating appendicitis.*" In these cases the onset is very much more acute, and, unless speedy relief be obtained by operation, death may occur within two days. The patient is suddenly seized with violent pain in the right iliac fossa, and all the symptoms indicating perforation of the bowel with escape of its contents (see p. 298); these symptoms

are most strongly marked in cases of gangrenous appendicitis, and in them the patient may never properly recover from the initial shock.

In the true cases of fulminating or perforative appendicitis there has been no time for the formation of adhesions to shut off the appendix from the general peritoneal cavity, and consequently the result of the perforation or of the gangrene is an immediate infection of the peritoneal cavity, in the first instance in the immediate neighbourhood of the appendix, but steadily tending to spread over the abdomen generally. Unless speedy relief be obtained by operation, the patient develops an acute general peritonitis with violent sepsis. Acute general peritonitis is dealt with separately (see Chap. XXI.).

The foregoing is a short sketch of the different types of appendicitis, but we would again repeat that the diagnosis of the particular form of appendicitis present is often a matter of extreme difficulty, and yet is a matter of the utmost importance from the point of view of treatment. Perhaps the form most easily diagnosed is the fulminating or the perforative appendicitis. When a patient hitherto in perfect health, or possibly suffering only from symptoms of mild appendicitis, is seized with a sudden violent pain in the right iliac region, accompanied by collapse and the signs of peritonism, it will at once strike the practitioner who is on the alert that some very alarming condition is present, and the diagnosis of perforation of the appendix and the necessity for immediate surgical intervention will be fairly clear. But, apart from these cases, it is extremely difficult to decide whether suppuration has occurred or whether the case is one likely to end in suppuration. We have already referred to three points as indicating the presence of suppuration (see p. 376), but this question may arise when the surgeon is called to a case of appendicitis within a day or two of the commencement of the symptoms, and even at that early period it is very important to know whether the case is one in which recovery without suppuration will take place or not. If suppuration be not likely to occur it is no doubt safer to defer operative procedures until the attack has completely passed off, and indeed for two or three weeks afterwards, whereas on the other hand, if it be likely to end in suppuration, the question of immediate operation will arise, or if that be put aside, the surgeon will be on the watch to intervene the moment pus forms, because it is never wise to leave a collection of pus in the peritoneal cavity any longer than can be helped.

Considerable assistance in coming to a conclusion on this point has of late been given by an enumeration of the leucocytes in the blood in these cases. In suppurative affections leucocytosis steadily increases up to a certain point, and it is on this steady increase that the diagnosis of impending or actual suppuration can be made. We therefore consider it most important that in any case of appendicitis the medical attendant should make repeated examinations of the blood (*vide infra*) so as to see whether there be any marked and steady increase in the leucocytosis. If this be so, the

diagnosis of suppuration may be made. A single leucocytic count is not of such certain value; it is not so much the number of leucocytes present at a given time as their steady increase in number which is the diagnostic point, and, unless the practitioner has already been making observations in this direction, a single examination made by the surgeon at the time of consultation will not give an absolutely definite result. At the same time, if on examining the blood in a case of acute appendicitis the surgeon finds that the white corpuscles are increased to say 25,000 per cubic millimeter, the probability is that pus has already formed. Dr. Otto Grünbaum, Clinical Pathologist to King's College Hospital, has been good enough to furnish us with the subjoined note on the clinical examination of the blood for this purpose; it is necessarily brief but gives the chief points:

"Acute abscesses are usually accompanied by an increase in the number of white cells in the blood, and as the abscess extends the leucocytosis becomes more marked. Two data are required, the number of white blood corpuscles per cubic mm. of blood, and the percentage of the different kinds of leucocytes.

"The selection of the methods of making these observations rests upon their simplicity and the ease with which they can be applied in practice rather than upon their scientific accuracy.

"The apparatus and solutions required are:

(1) A Thoma pipette.
(2) A Thoma counting chamber.
(3) Clean cover glasses and slides.
(4) Toisson's solution.
(5) Jenner's blood-stain.
(6) A syrup of Canada balsam in xylol.

"*A Thoma pipette* is a graduated capillary tube widening towards one end into a small bulb; by sucking blood up to different marks in the capillary tube and then drawing up fluid into the bulb the blood can be diluted to any degree between 1 in 100 and 1 in 1000.

"*The Thoma counting chamber* consists of a slide one surface of which is ruled into squares by lines $\frac{1}{20}$ mm. apart. The cover glass rests on a support which makes the height of the chamber $\frac{1}{10}$ mm.

"Since the successful preparation of a blood-film depends largely upon the cleanliness of the cover glass, it is well to take trouble in freeing the glass from grease.

"A reliable way is by boiling the glasses in a 2% aqueous solution of potassium bichromate to which 5 parts of sulphuric acid have been added, rinsing in running water and transferring to distilled water. The glasses are then dipped into absolute alcohol and kept in a mixture of equal quantities of ether and absolute alcohol; before use they are wiped with a grease-free cloth.

"*Toisson's solution* consists of:

Sodium chloride,	1	part.
Sodium sulphate,	8	parts.
Neutral glycerine,	30	,,
Methyl violet., 5 B.,	0·025	,,
Distilled water,	160	,,

The solution should be filtered just before use.

"*Jenner's stain* is a 0·5% solution of a salt of eosin and methylene blue in pure methyl alcohol. The purity of the alcohol is of considerable importance.

"Blood is obtained from the lobe of the ear after washing the surface with absolute alcohol. The first drop is wiped away, part of the second drop is drawn up in the pipette to the mark 1; the tip of the pipette is rapidly freed from blood and plunged in some freshly filtered Toisson's fluid. This mixture is sucked up until the mark 101 is reached. The pipette is rolled and shaken to insure the satisfactory mixing of the blood and must now be kept horizontal. A film is prepared by allowing the centre of a clean cover glass to come into contact with a fresh drop of blood, and laying it upon another cover glass. After the drop has spread the glasses are separated by sliding them apart rapidly and the films are dried by waving them in the air. It is of importance that this method be adopted when a differential count is going to be made because sliding-edge methods are unreliable since the polynuclear cells stick to the moving body.

"Having procured these preparations, further examination may be carried out at a distance from the patient.

"The pipette is well shaken and rotated, a few drops are blown out, a drop is placed in the centre of the counting chamber and the cover adjusted. The size of this drop should be large enough to fill the space between the raised part of the chamber and the cover glass, but should not overflow into the moat. Whilst the corpuscles are settling in the chamber the films may be stained.

"Without any previous fixing, Jenner's stain is poured on to the films; evaporation is prevented by covering. After one to three minutes the stain is drained off and the film washed in distilled or running water until it assumes a terra-cotta tint; it is then dried between blotting paper and mounted in xylol balsam.

"On examining the film with a microscope magnifying 500 diameters four different kinds of white cells can be distinguished.

"*Polynuclear neutrophile cells*, 10μ diameter. The nuclei are stained blue and are apparently multiple; the cell substance does not take the stain but contains flint-shaped granules of a terra-cotta hue.

"The *lymphocytes* are but slightly larger than the red cells; they consist of a large nucleus of a deep blue colour surrounded by a narrow ring of cell substance which is only tinged blue.

"*Large mononuclear cells* of 9μ to 12μ diameter. These cells have a horseshoe-shaped nucleus, which may appear of other forms, depending upon the lie of the cell. The greater part of the cell consists of a substance which is of a faint blue colour.

"*Eosinophile cells* are about the same size as the large mononuclear cells. Their nuclei are multilobulated, and the cell substance contains large rounded granules which take a bright red stain.

"Five hundred white cells should be classified and the percentages calculated.

"In adults the normal percentages are: Polynuclear cells, 63 to 75; lymphocytes, 20 to 30; large mononuclear eells, 4 to 8; and eosinophile cells from 0·5 to 4.

"An increase in the percentage of polynuclear cells points to an inflammatory condition.

"The number of white cells present is now determined. The counting chamber is placed under the microscope and the size of the field noted; if the diameter of the field is not some multiple of 1/20 mm. the draw tube is pulled out until this is attained.

"For instance, if the number of the squares be 8, then the volume of the mixture seen at one time in the counting chamber would be $(\pi r^2 h) = \frac{22}{7} \times \frac{1}{20} \times \frac{1}{20} \times \frac{1}{10}$, viz. $\frac{1}{79{\cdot}51}$ of a cubic mm.

"The number of white cells (which are now easily distinguished from the red by their deep violet colour) seen in fifty different fields is counted and the average calculated. This number is multiplied by $79{\cdot}51 \times 100$ since the blood has been diluted 100 times.

"If the diameter of the field of the microscope were $2x$ squares the average number per field would have to be multiplied by $\frac{12727}{x^2}$ in order to determine the number of white cells per cubic mm. of blood.

"Only above 9000 white cells per cubic mm. is considered abnormal. If there be a marked leucocytosis (*e.g.* more than 15,000 per cubic mm.) another count should be made after a few hours to decide whether there be an increasing or decreasing leucocytosis present.

"In drawing deductions from the above observations one must bear in mind that a normal blood count may attend the following morbid conditions: (1) A mild inflammation, (2) an overwhelming toxæmia, (3) an abscess with very thick walls.

"An increasing leucocytosis indicates a spreading of the inflammatory condition and usually the formation of pus.

"A gradual diminution in the number of leucocytes points towards resolution of inflammatory material.

"If an increasing polynuclear leucocytosis be present, since it generally, although not invariably, indicates the formation of pus, the necessity of operative intervention must be considered in spite of apparent amelioration of symptoms.

"It must be fully understood that a normal blood count or a leucopenia in the presence of signs and symptoms of pus must not for a moment stay the surgeon's hand."

TREATMENT.—(a) General considerations.—Opinions are by no means unanimous at the present time as to the treatment of appendicitis. The real points at issue are: the cases suitable for operation; the period at which the operation should be performed; and the extent of the operation and the method of performing it under different circumstances.

The cases requiring operation.—There is no dispute that in the *perforating* and *fulminating* forms immediate operation is the only chance that the patient has. Similarly, when there is reason to suspect the *presence of pus* there is no divergence of opinion as to the necessity for operation, although there is considerable discussion as to the period at which the operation should be performed and as to the extent of the operation necessary. These points are referred to later (see p. 383).

A question has arisen *whether, after the occurrence of suppuration and the healing of the abscess, an attempt should be made to remove the remains of the appendix.* At one time it was held that the appendix was destroyed or obliterated when suppuration occurred, and that there was no risk of any further trouble. This does not however seem to be the fact. We have ourselves met with several cases where subsequent attacks of appendicitis have occurred after the healing of an appendicitic abscess, in one or two suppurative and in one fatal. We are therefore inclined to advise that, unless the appendix has certainly sloughed or has been got rid of when the abscess was opened, an attempt should be made to remove

the process after healing is complete. As a matter of fact, when an appendicitic abscess has been drained for some time, a weak spot is left in the abdominal wall which is very likely indeed to become the seat of a hernia, and this not infrequently requires to be remedied. It seems to us that it is well to open up the parts some little time after the abscess has healed with the object of suturing this defect in the abdominal wall and of removing the remains of the appendix.

As regards the *typical relapsing appendicitis* where several attacks have occurred, especially if they are severe, surgeons are practically unanimous in holding that the appendix should be removed. Opinions no doubt differ as to the number and severity of the attacks which justify operation, but when the attacks have been severe the general opinion is in favour of operation.

As regards *catarrhal appendicitis*, it must be admitted that it is by no means easy to be quite sure that any given case is a simple catarrh of the mucous membrane. At the same time there is no doubt that a considerable number of cases of appendicitis are so extremely mild that operative interference does not seem to be called for, in the early stage at any rate. Further, catarrh of the appendix is a condition which may recur, and if these recurrent attacks be extremely slight it may still be a question as to whether it is justifiable to operate or not. On the whole however we are inclined to the view that even in mild relapsing cases, such as seem to be purely catarrhal in nature, it is well to remove the appendix. We have so often found grave disease of the appendix in cases where none of the attacks had been really severe that on the whole we consider removal of the appendix as less dangerous than leaving it alone. As a matter of fact the dangers of removal of the appendix are very slight in mild cases; we have removed large numbers of appendices, some of the operations being of extreme difficulty, without losing a patient. The less severe the symptoms and the fewer the adhesions, the easier is the operation and consequently the greater is its safety; and it is just in these cases where the indications for operation are doubtful on account of the mildness of the attacks that the procedure will probably be so simple that the mortality ought to be *nil*. The danger of the operation in fact varies inversely with the doubt as to whether it should be performed and these mild cases may be operated on with much less anxiety than the more severe ones, while the methods of operating which are in vogue at the present day do not involve weakening of the abdominal parietes, which at one time was a great argument against operation except in cases of necessity.

Another very important point is *whether under any circumstances it is well to advise removal of the appendix when there has only been one attack*, the general opinion being apparently that a second attack should be waited for. In our opinion the answer to this question depends on the severity of the attack. In the case of a mild one, which may quite well be catarrhal in nature, we do not advocate operation. But, when the first attack has been

severe and accompanied by symptoms of peritonitis, such alterations in the appendix itself are indicated as to remove the case from the category of a simple catarrhal appendicitis and in these cases we see no reason for waiting for a second attack, which indeed might prove fatal. We are therefore of opinion that in all cases in which there are distinct signs of inflammation of the peritoneum around the appendix in the first attack, the patient should be advised to have the appendix removed as soon as the acute attack and the thickening have passed away, provided always that there be no constitutional or local contra-indication.

Cases of repeated *appendicular colic*, even without any elevation of temperature at all, should also be subjected to operation. In these cases a stricture, a kink or a concretion will generally be found.

The most suitable time for operation.—Here, again, opinions differ. *In fulminating and perforating cases* operation should of course be performed at once. Some have advocated that *in suppurative cases* time should be allowed to elapse so as to permit of extension of the peritonitic inflammation to the anterior abdominal wall, thereby securing adhesions which will shut off the general peritoneal cavity from the abscess cavity and thus render operative interference safer. Others, on the contrary, urge operation as soon as there is reasonable ground for believing that pus is present, quite irrespective of the question as to whether the abscess cavity is adherent to the anterior abdominal wall or not. There are arguments in favour of either view,—in favour of waiting it may be urged that, if the mass be adherent to the anterior abdominal wall, an incision will evacuate the pus without any risk of diffusing it into the general peritoneal cavity; on the other hand, if the abscess be opened as soon as pus has formed and there be no adhesions between the intestines and the abdominal wall the pus in its passage is very likely, in spite of the most careful precautions, to escape into the general peritoneal cavity and set up acute suppurative peritonitis. The question is whether there is more risk in waiting for adhesions to the abdominal wall or in opening the abscess at once in spite of the risk of the pus infecting the peritoneal cavity. This risk however is really exceedingly slight if care be taken before disturbing the parts to pack off the peritoneal cavity; if the abscess be completely emptied, if good drainage be established with gauze packed around the drainage tubes so as to shut them off from the peritoneal cavity, infection very seldom results; we do not remember any case of the kind in our own practice. The irritation of the gauze around the tube soon leads to adhesions, and in the course of 24 hours the peritoneum is shut off all around and the tube runs direct into the abscess without any communication with the general peritoneal cavity.

On the other hand, although the chances of peritoneal infection are not great when the pus has become localised and forms a definite abscess, still an accident may occur as the result of a violent movement, of pressure, or of violent peristalsis; rupture of the adhesions and infection of the peritoneal

cavity may take place while the surgeon is waiting for the mass to become adherent to the anterior abdominal wall. Or again, the infective material may become more virulent; a case that has been going on quietly may suddenly, possibly on account of the access of fresh bacteria through a perforation in the appendix, become more active and may spread in spite of limiting adhesions. Another objection to waiting is that the abscess as it enlarges may spread, not to the anterior abdominal wall, but downwards into the pelvis, or may burst into the intestine; there is the further risk of phlebitis and thrombosis or pyæmia or septicæmia from the continuance of virulent pus in the peritoneal cavity. So that there are very distinct risks in waiting for the abscess to extend to the anterior abdominal wall.

On the whole, we are of opinion that the sooner an abscess is opened the safer it is for the patient. These cases are always anxious and dangerous ones, but it is quite unsurgical to sit by and watch the growth of an abscess in any part of the body.

At what period should operation be undertaken in relapsing cases?—There is considerable difference of opinion on this point. Some surgeons are gradually coming to the conclusion that the time for operation is the moment they are called to a case of appendicitis; on the other hand, the view held by many is that operation should be deferred if possible until the attack has passed off and the appendix is in a quiescent state. There is no question that an operation with the patient in perfect health, some weeks after an attack of appendicitis, when there is no longer any swelling to be felt, is accompanied by a minimum of risk; the question really is whether one should operate at once on cases of acute relapsing appendicitis or should wait. The objections urged against waiting are mainly the uncertainty as to the future course of the case. It is quite possible that the particular attack in which the surgeon sees the patient may run an unfavourable course, the appendix may perforate, suppuration may occur and the patient's condition may alter very materially for the worse; and this uncertainty leads some surgeons to advocate immediate operation at whatever period the case is seen. A second point is that the patient may recover from the attack, but that, while waiting for the operation to be performed, another serious attack may supervene.

We cannot however help regarding operation during an acute attack, when there is no definite reason for presuming that pus is present, with a certain amount of hesitation. No doubt, if called to a case of relapsing appendicitis within the first few hours of the acute attack, the surgeon would be quite justified in operating at once and we are very strongly inclined to advocate this. During the first few hours in a non-perforative case the micro-organisms setting up the trouble are presumably still within the appendix and have not penetrated to the peritoneal cavity, and therefore the manipulations involved in the removal of the appendix need not diffuse septic material through the peritoneum. On the other hand, after 24 hours in severe cases there is inflammation of the peritoneum around, and this very fact implies

that bacteria have passed through the wall of the appendix and have begun to grow in the peritoneal cavity. If left alone, they are likely to remain limited to the region of the appendix by virtue of the adhesions that so rapidly occur around; but if the adhesions be torn through and the appendix removed, the lymph infected with bacteria may lead to a general peritoneal infection, and we have certainly seen cases where there was reason to believe that this had resulted from interfering at this stage of the disease. For our own part therefore we are inclined, if the favourable moment for operation (namely, the first few hours) has passed, to delay operation. Meanwhile careful watch must be kept, several times a day if necessary, to see whether suppuration is taking place or not, and in this connection a careful and repeated blood-count (see p. 379) is of great importance. Should there be evidence of suppuration, then of course the operation must be performed (*vide supra*); on the other hand, should the attack pass off without suppuration, we think it advisable to wait until all the thickening has gone before removing the appendix.

When the attack has passed off, it is probably best as a rule to allow at least a fortnight to elapse from the fall of the temperature to normal, and in most cases it is well to wait until all the thickening has disappeared, unless a fresh attack threatens. In about a fortnight any bacteria at work outside the appendix will probably have died out and there is then no reason to fear peritoneal infection. Should a fresh attack be threatening however, the operation should be proceeded with without further delay. It is well when operation is decided upon not to allow the patient to get out of bed from the time of the attack until after it has been done. Certainly he should not be sent away from observation in order to recruit.

The extent of the operation required.—In the perforative or relapsing cases the whole object of the operation is to remove the appendix. There is however much diversity of opinion as to whether, in cases of localised suppuration, the surgeon should content himself with opening the abscess or should remove the appendix in addition. The objections to the latter procedure are that very often the appendix forms part of the wall of the cavity shutting it off from the general peritoneum, and that its removal may cause the formation of an aperture leading straight into the peritoneal cavity and that, even though the appendix does not form part of the abscess wall, the manipulations required to remove it may tear through the adhesions which shut off the cavity and lead to general infection of the peritoneum. This question of dealing with suppurating appendicitis will be fully discussed immediately (see p. 393). We may say here that our inclination is rather to content ourselves with opening the abscess than to make any attempt to remove the appendix while the infection is of a virulent and acute character.

(b) **Treatment of individual cases.**—We shall consider the treatment of the following clinical types:—1. Catarrhal appendicitis; 2. Appendicitis due to graver changes in the appendix; 3. Relapsing

appendicitis; 4. Gangrenous and perforating appendicitis; 5. Suppurative appendicitis; and 6. Sinuses left after the opening of an appendicitic abscess.

1. Treatment of catarrhal and other forms of appendicitis in which operation is not considered advisable.—The first essential is to put the patient to bed in the recumbent position with the knees flexed over a pillow. While the vomiting lasts *food* should not be given by the mouth; frequent sips of hot water are useful here. The vomiting generally passes off in a few hours and the patient may then be given liquid food, such as milk and lime-water or liq. calcis sacch., or small quantities of meat-juice or soups. No solid food should be given until the temperature has remained normal for several days. Stimulants are generally unnecessary during the early stages and are better avoided. *Salol* in five- to ten-grain doses in cachets, or *naphthaline* in three-grain pills, should be given three times a day as an intestinal antiseptic, and liq. ammon. acet. may be administered. On no account should purgatives be given in the early stages; a common mistake is to pay too great attention to the constipation, and violent efforts are often made quite early in the disease to bring about an action of the bowels and this no doubt is to a great extent the patient's fault because he feels that if his bowels would act he would be much relieved. The utmost that should be done, and that only with caution, is to give a soap and water enema; in the first two or three days even this is unnecessary. Castor oil should be absolutely avoided.

The administration of *opium* has been much debated. When the patient suffers much pain there is a great temptation to give the drug, which is held to diminish peristaltic action and so to give the bowel rest. But opium largely masks the symptoms and a patient under its influence may be so comfortable that it is impossible to judge properly as to the progress of the disease; the same remark applies to antipyretics. If the pain be acute, the smallest dose of opium sufficient to quiet the pain should be given and only this if absolutely necessary. Belladonna or quinine will very often relieve the patient and they do not possess the disadvantages that opium does.

Among the *local applications*, cold is probably the best in quite the early stages; an ice-bag or, still better, Leiter's tubes with water running through them at a temperature of 50° to 60° F. are very useful. In the later stages however the patient generally derives more comfort from warm fomentations. Blisters or counter-irritants should not be employed, as we never know when it may be necessary to operate, and the skin must therefore be kept in as healthy a condition as possible. Leeches are sometimes employed, but they are hardly likely to arrest a suppurative appendicitis, and they damage the skin and interfere with the subsequent operation, should one become necessary.

When the temperature has fallen to normal and the side is getting less tender, it is time to promote the action of the bowels, which should

be done partly by enemata and partly by mild salines by the mouth. The simplest plan is to commence with drachm-doses of sulphate of soda every four hours until the bowels act; when there has been constipation for four or five days it will often be two days before the bowels act under this treatment. Enemata may be employed coincidently, but neither the surgeon nor the patient need be in a great hurry to obtain a complete action of the bowels; the constipation is temporary and will pass off with the cessation of the inflammation. Violent attempts only aggravate the inflammation; indeed recurrence of the disease ending in suppuration may follow the administration of strong purgatives when the primary attack has apparently subsided. The patient should be kept in bed for several days after the temperature has fallen to normal; he should not be allowed to get up until any thickening present has quite disappeared.

2. Treatment of the more severe cases.—In severe cases it will be best to remove the appendix at once, should the surgeon see the case within the first twelve hours; if the case be seen later, it is better to watch the progress of events and to intervene only if suppuration makes it necessary. A careful blood-count must be kept. If the temperature falls in the course of four days, suppuration probably will not occur, but all likelihood of this danger must not be considered to have ceased until the swelling has absolutely disappeared, and it is therefore well to keep the patient in bed until this has happened. The treatment is similar to that for the catarrhal cases (*vide supra*); but we would recommend that the appendix should be removed when the attack has passed off and before the patient begins to go about, *i.e.* in two or three weeks from the subsidence of the febrile attack. We have never yet removed an appendix which did not show changes rendering its removal very advisable, while on the other hand we have regretted leaving others, and have seen many cases where an application of the advice given above on this point would have been very much to the patient's advantage.

3. Treatment of relapsing appendicitis.—Surgeons are practically unanimous that the appendix should be removed in severe cases of appendicitis after one relapse, without further delay; this opinion we fully endorse. Two chief points have to be borne in mind in operating on these cases: (1) To get good access to the appendix; and (2) to avoid unnecessary damage to the abdominal wall.

Operation.—When there are few adhesions, the appendix can be easily removed through quite a small opening; when the adhesions are extensive, the opening must be larger and the removal of the process must be very carefully effected lest damage be done to structures to which it is adherent. Apart from this, room is necessary not only to see what one is doing, but sometimes even to find the organ itself, as this is by no means easy when there is much matting of the intestine.

Incision.—We have already referred to the method of opening the abdominal cavity without dividing any of the muscles (see p. 188). The

best incision is oblique from above downwards and inwards with its centre about an inch and a quarter internal to the anterior superior spine of the ilium. This is carried down to the external oblique tendon, the fibres of which are separated with the handle of the knife in the same direction as and throughout the whole length of the superficial wound; it is unneces-

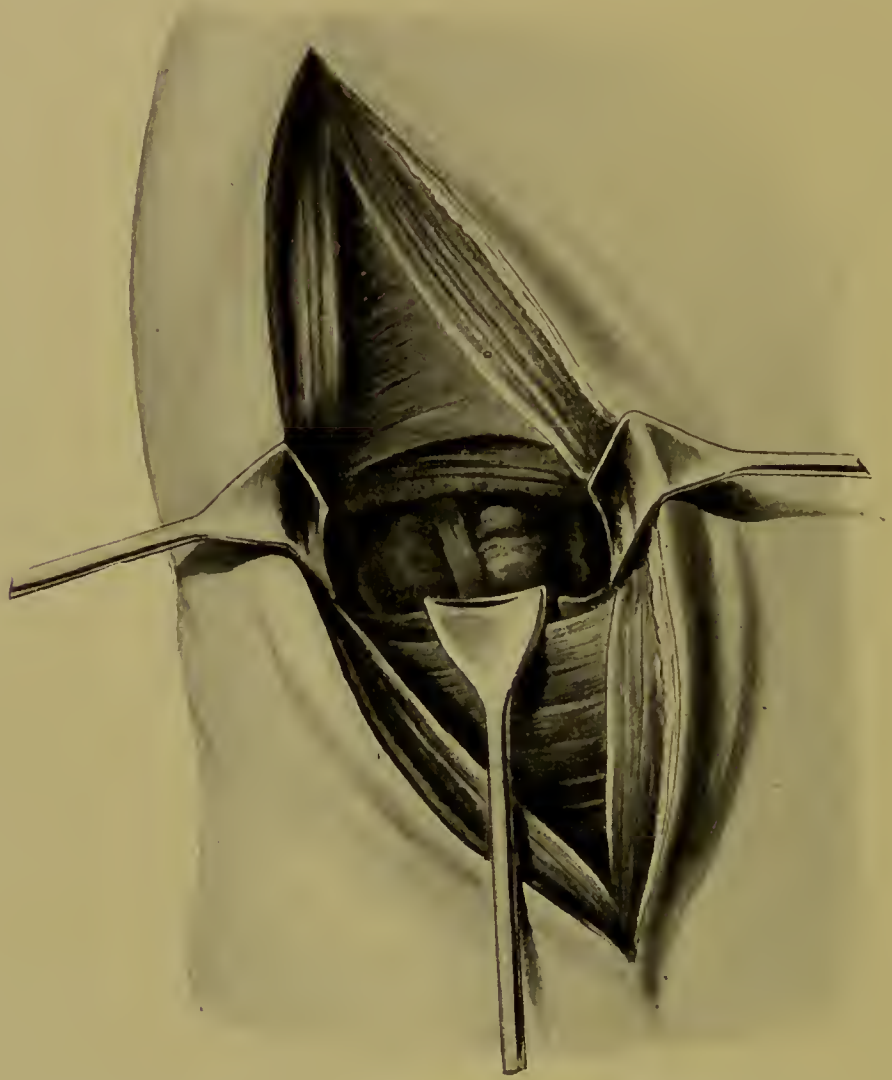


FIG. 103.—METHOD OF SPLITTING THE ABDOMINAL MUSCLES IN THE OPERATION FOR REMOVAL OF THE APPENDIX. The three muscular layers of the abdominal wall are seen, each one split in the direction of its fibres. It shows the disproportion in size between the skin incision and that through the peritoneum. Firm retraction, with the retractors arranged as above, is necessary to get as much room as this.

sary to cut any portion of the tendon. The finger is swept round between the external and internal oblique and the former can then be widely retracted. The internal oblique muscle is now exposed, running practically transversely across the abdomen, and should be separated with the handle of the knife. Much depends on doing this at the proper spot; if the root of the appendix can be exposed at once there will probably be no need to enlarge the wound; but when the latter is out of place there may be some difficulty

in reaching it. The exact point at which to separate the muscular fibres is to some extent determined by the situation of the pain; when this is higher up than usual, the fibres of the internal oblique should be separated a little above the level of the anterior superior spine and *vice versâ*. During the acute stage, a note of the position of the greatest tenderness should always be made with this point in view.

With a little deviation the fibres of the transversalis are also separated by the handle of the knife and the sub-peritoneal fascia is exposed; the opening-up of the wound is completed by stretching with the fingers. The internal oblique and transversalis muscles are split to the edge of the rectus. Three large retractors are required; one above, one below, and one in the anterior angle of the wound; this gives an area about the size of half-a-crown, which is quite sufficient to work in when there are no extensive adhesions. If more room be necessary it is easy to split the sheath of the rectus without injuring the external oblique tendon; this gives good access towards the brim of the pelvis. Not only does this avoid dividing muscles and so weakening the abdominal wall, but the nerves are not divided, and so paralysis of portions of the abdominal wall is avoided. There is however no question of enlarging the wound until the peritoneum is opened. The wound can always be further enlarged upwards or downwards if necessary by dividing the fibres of the internal oblique and transversalis muscles. We advise that exposure of the region of the appendix should be effected by mere separation of muscular fibres, and that no division of the latter should be resorted to until it is found unavoidable.

The transversalis fascia and the peritoneum are now divided. When the case has been quiescent for some time there is usually no adhesion of the intestines to the parietal peritoneum, but care must always be taken to make sure. A nick is made in the peritoneum, and the latter is slit up with a pair of scissors in the same direction as the external wound.

Finding and freeing the appendix.—The next step is to identify the cæcum which usually presents in the wound; it is easily recognised by its muscular bands. The anterior band is seized between the thumb and finger and the cæcum is gently pulled out from below. As this is done, the base of the appendix may often be recognised and the finger slipped down along it will ascertain if adhesions are present; if so, and if they be quite fine, the finger will tear them across and allow the appendix to be brought out into the wound. As the head of the cæcum is pulled out, the upper part is tucked back again into the abdominal cavity.

The best way to free the appendix is to begin from the tip of the process, which must be exposed as fully as possible by pulling the edges of the wound to whichever side may be necessary. Any adhesions are then torn through with the finger or a dissector. This is sometimes a work of the greatest difficulty; if the appendix be adherent to the intestine, it is not uncommon for the adhesions to be so firm that the bowel may be injured in trying to peel the process off it. Or, again, the cavity of

the appendix may actually communicate with that of the intestine at the point of adhesion, and detachment of the appendix inevitably leaves a hole in the latter. Should such an accident happen the hole must be stitched up as in ordinary intestinal wounds (see p. 303). When the appendix has been separated right up to its attachment to the cæcum, the meso-appendix is clamped, cut across, and the proximal end tied with catgut.

It is quite impossible to give any idea of the difficulties met with in actual practice, but the principle to go upon is first to find the lower end of the cæcum and the ileo-cæcal valve and then to try to find the apex of the appendix; should the latter step be impossible, the base of the process must be identified either by sight or by grasping the cæcum below the ileo-cæcal valve, and rolling the appendix under the finger. This is particularly useful when the adhesions have extended over the cæcum and the appendix so as to obliterate all trace of the actual attachment of the two structures. When once the appendix is felt rolling under the finger the adhesions over it may be separated and its base defined without great difficulty; then, working downwards from the base, the adhesions are separated and the appendix defined, or the process may be cut across in the manner described on p. 391, and the remainder of the appendix gradually shelled out from the adhesions in which it is involved. This latter procedure is usually, however, unnecessary; with the expenditure of a little time and trouble the appendix can generally be cleared from the apex to the base.

Removal of the appendix.—When the appendix is quite free and all hæmorrhage has been arrested, the head of the cæcum and the appendix itself are pulled well out of the wound so as to complete the operation outside the abdomen. There is usually no difficulty in doing this; at most, a few adhesions of the cæcum itself may have to be torn through before the latter is sufficiently freed. It is much more easy to deal with the stump of the appendix outside the abdomen than at the bottom of a small hole.

There are two chief methods of removing the appendix, viz., the formation of a cap of peritoneum over the end of the stump or the inversion of the latter into the cæcum; the choice will depend on the condition of the parts. Inversion of the stump is not practicable in the majority of cases because the appendix is inflamed and rigid right up to its root and it cannot be turned inside out; but when it is quite limp the simplest plan is to invert it after cutting it across, so that it projects into the ileum, and to keep it there by a row of Lembert's sutures.

When the appendix is rigid and will not invert in this manner, the best plan is to divide the peritoneal coat circularly about half-an-inch beyond its base and to turn back a cuff of peritoneum with a dissector. This is easy except at the attachment of the meso-appendix where the vessels will require division. The reflection of the peritoneal coat should be continued right up to the point of attachment of the appendix to the

cæcum, and then a ligature is tied firmly around the denuded muscular coat of the appendix at its point of attachment and the process is cut off just below it (see Fig. 104). An abdominal cloth is packed closely around the appendix before section, after which any mucous membrane beyond the ligature is removed with a fine scoop and the surface touched with

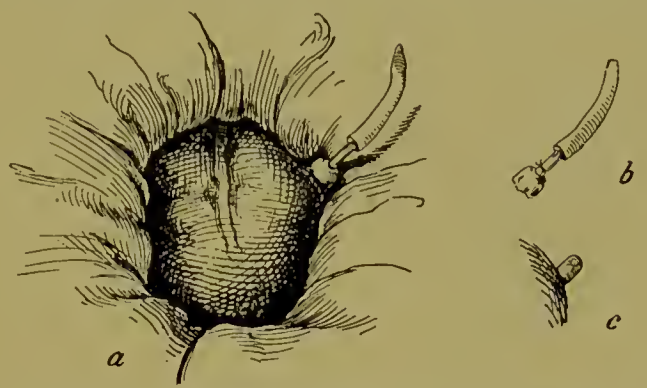


FIG. 104.—METHOD OF COVERING IN THE OPEN END OF THE APPENDIX. *a* shows the cuff of peritoneum turned back all round after the circular incision through the peritoneal coat. In *b* a ligature is applied around the mucous membrane as high up as possible. The appendix is then cut off and the peritoneal cuff turned down and sutured over the top of it as shown in *c*.

undiluted carbolic acid so as to disinfect it. The ligature is cut short and the peritoneal cuff is turned down and tied or stitched over the end. As a rule this suffices, but if there be any doubt as to the integrity of the peritoneal cap, it is well to bring the wall of the cæcum together over it by two or

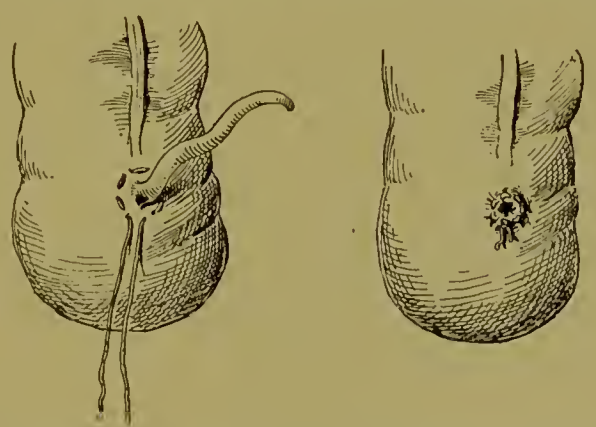


FIG. 105.—METHOD OF INVAGINATING THE BASE OF THE APPENDIX. In the left-hand sketch a purse-string, sero-muscular, suture is first inserted, and the appendix is then cut off flush with the cæcum. The purse-string suture is drawn tight and, while this is being done, the stump of the appendix is pushed into the cæcum with a probe. When the suture is tied, the stump of the appendix is inverted and puckered up, as shown in the right-hand figure. This is finally buried by Lembert sutures.

three Lembert sutures. Dr. MacBurney cuts off the appendix before he applies the ligature because he has found that a stricture may be situated between the point of division of the appendix and the valvular communication with the cæcum, in which case a small canal is left between the stricture and the ligature which may cause recurrence of the trouble. He cuts the appendix across as close to the cæcum as possible, introduces a probe

to see whether a stricture is present, scrapes away the mucous lining of the stump and destroys it either with a cautery or with undiluted carbolic acid; he then buries the stump in the wall of the cæcum.

Another good method is to run a purse-string suture around the base of the stump about an eighth of an inch from it before dividing the appendix at all. After the latter has been cut off, this suture is tightened and the stump is meanwhile pressed well inwards with a probe, so that, when the suture is tied, it occludes the open end. Two or three Lembert sutures are applied outside so as to perfect the occlusion (see Fig. 105). It is well to remember the various ways of dealing with the stump because cases differ very much and no one plan is applicable to all.

Closure of the abdominal incision.—The area of operation is now carefully sponged, the packing is taken away, the cæcum is returned into the abdomen and the abdominal wound is closed. First of all a continuous catgut suture unites the peritoneum; then the external oblique is retracted and the deeper muscles are fully approximated throughout the line of separation of their fibres by a few catgut stitches. The external oblique is next brought together with a continuous catgut suture and the skin is closed in the usual manner. When the muscle fibres have been divided transversely, greater care must be taken in stitching them up; this must be done on the lines already referred to (see Part II., p. 200).

After-treatment.—The patient should not be allowed to get up for three weeks, so as to permit of the proper repair of the abdominal wall. The dressing does not as a rule require changing for about ten days, when the stitches may be removed and a small collodion dressing applied. The food should consist of slops for the first few days until the bowels have acted. If there be much pain, opium may be given sparingly for the first day or so. Flatulence often gives rise to some trouble and will require to be treated by the use of the rectal flatus-tube and also by the administration of aromatics such as ginger, etc., while salol given by mouth often diminishes the formation of gas. At the end of the fourth day phosphate of soda, in drachm-doses every four hours may be begun, while on the fifth, a copious enema should also be given; if that fail, a dose of castor oil will obtain a proper evacuation.

4. Treatment of gangrenous and perforating appendicitis.—Immediate operation is essential here, and everything depends on the practitioner recognising the condition of affairs and calling in the surgeon at the earliest possible moment. There is no question of saving the abdominal wall; the main point is to save the patient's life, and therefore the ordinary oblique incision is made through the skin and the muscles right into the abdominal cavity. The general abdominal cavity is packed off by cloths and then the cæcum is pulled aside and the appendix looked for; it may either be represented by a sloughing mass or there may be fæcal material exuding from a perforation in it. Within the first six hours the infection remains limited to the area of the appendix and the intestinal coils ought

not to be separated for the purpose of general disinfection of the abdomen; neither is it advisable to flush out the area, because the fluid may separate the coils and carry infective material into other parts of the abdomen. All that need be done is to separate the coils sufficiently to give access to the appendix; if this be gangrenous, it must be removed and a ligature may be put on the stump; if it be perforated, a ligature is applied to the base and the process is cut off. There is no need to bury the stump because the whole appendix is a septic mass. All infective material is carefully sponged away from the vicinity of the cæcum without unduly separating the parts, and iodoformed gauze is lightly packed into the area left by the appendix, and the wound left widely open. It is well to introduce one or two drainage tubes into the middle of the gauze right down to the seat of perforation.

Strychnine and stimulants must be freely resorted to during and after the operation and the treatment for shock in abdominal operations (see p. 177) must be followed. The packing should be left in for about two days; as its removal is usually painful, it should be effected under gas and ether if the patient be in a very weak state. The packing may then be left out and drainage tubes only employed. If an anæsthetic be given for the first dressing, it is well to introduce a series of silkworm-gut stitches through the skin, muscles and peritoneum, leaving them with their ends loosely knotted together with the view of gradually closing the wound in the abdominal wall as the discharge gets less and the patient begins to recover. The external wound should be packed in order to prevent the intestine escaping.

5. **Treatment of suppurative appendicitis.**—The two principal conditions met with here are cases in which the mass containing the abscess is adherent to the anterior abdominal wall and those in which adhesion has not taken place.

When there are adhesions to the anterior abdominal wall.—These collections should as far as possible be opened at some adherent spot and for a swelling in the iliac fossa it is well to make the incision about half an inch internal to the anterior superior iliac spine and to carry it along just internal to Poupart's ligament so as to get well to the region where adhesions are most likely to exist. The operation is carried out as above (see p. 387) except that the incision is made somewhat further out. Care must be taken in opening the peritoneum lest the cæcum be adherent to it; if adherent, the softened peritoneum may be scraped through and the pus allowed to escape. The enlargement of the opening must be done cautiously so as not to detach more adhesions than necessary. As much of the pus is allowed to escape as will come away and the finger is then introduced and the cavity examined very carefully. There are often recesses extending upwards and backwards towards the lumbar region or perhaps downwards into the pelvis and all these should be explored with the finger, but great care must be taken not to bore into the general peritoneal cavity. When the abscess runs backwards towards the iliac crest, a counter-

opening there will greatly facilitate drainage. If a concretion be present, the finger should detect it and it can be removed with forceps.

The debateable question at the present time is whether the appendix should be removed.—Some surgeons recommend that a freer incision should be made, the cavity well opened up and inspected, washed and sponged out thoroughly and then the appendix removed. In our opinion this is inadvisable, except possibly when the appendix hangs into the abscess cavity, and we would strongly advise that the organ be left for the time being. Neither do we see any advantage in washing out the abscess; on the contrary, there is considerable danger of rupturing the adhesions and infecting the abdominal cavity. To us it suffices to provide for proper drainage and, as for this purpose gauze drains alone will hardly suffice, we use in addition india-rubber tubes which do not press so injuriously on the bowel as glass ones may and which serve their purpose quite well. Large tubes should be employed and holes should only be cut in the part of the tube actually in the abscess cavity. When the cavity is shut off from the peritoneum there is no necessity for using gauze and we cannot convince ourselves that gauze wicks are nearly as efficient for the drainage of pus as are drainage tubes.

After-treatment.—This is practically the same as that of an acute abscess elsewhere, and the drainage must be continued as long as any discharge persists. Fresh suppuration not at all uncommonly occurs in some recess which has been insufficiently opened up and after a week or ten days, when the patient is going on perfectly well, the temperature may again rise and a fresh access of pain occur; this usually implies the pocketing of the pus and the formation of a fresh abscess, which however can usually be got at through the original opening. In any case it must be evacuated in whatever manner seems best under the circumstances.

Trouble may also arise from contraction of the aperture in the abdominal wall leading to difficulty in introducing the drainage tube. This may necessitate dilatation of the abdominal opening from time to time with graduated bougies; on no account should the tube be left out until the bottom of the cavity has filled up, because there will be difficulty in getting it through the skin opening again.

Another trouble may be some interference with the action of the bowels from the matting together of the intestines. This is most likely to occur when the suppuration has been in Douglas's pouch, and there may then be symptoms of partial obstruction. At the same time we have never seen anything worse than this and, except in cases of urgent necessity, we would not advise any further operative interference. The administration of salines such as phosphate of soda will usually keep the bowels acting, and the adhesions stretch after healing and the trouble improves.

When suppuration occurs in the female pelvis it is well first to open the abscess from a median laparotomy wound, and then, if its floor be

formed by the roof of the vagina this may be perforated and a drainage tube introduced from below. Merely making an opening through the roof of the vagina and not through the middle line first might damage a coil of intestine; moreover, if a tube be merely pushed into the cavity from below, any lateral recesses in the iliac fossæ are not properly drained. The incision in front opens all these recesses and then free drainage is established by a tube passed in through the vagina.

When there are no adhesions to the anterior abdominal wall.—The first thing is to get ample room to get at the parts, and then, after pushing aside the intestines, to shut off the peritoneal cavity by packing with cloths wrung out of salt solution (see p. 177). An attempt is then made to separate the adherent coils until the pus is reached. If the situation of the abscess allows, an endeavour should be made to work round the outer side of the cæcum so as to get behind and below it where the pus is most likely to be, but this will of course depend on the position of the latter. Many sponges on holders or forceps should be at hand to mop up the pus as quickly as possible and, in the first instance, the opening into the abscess should be quite small, as it is not desirable to flood the whole wound with pus as, were the packing by any chance insufficient, the general peritoneal cavity might be infected. With a small opening, the pus may be mopped up as it oozes out and additional packing may be added if necessary at the lower part as the abscess cavity becomes emptied. When the flow of pus has ceased, the coils can be gradually and gently separated so as to open up the abscess cavity and ascertain the exact state of affairs; great care must of course be taken not to break down more adhesions than is absolutely necessary.

The further treatment is practically identical with that already mentioned. One or more drainage tubes are introduced into the cavity, the abdominal cloths are removed one by one and gauze packing is inserted around the tubes so as to shut off the cavity of the abscess from that of the abdomen. The tubes should be large enough to practically occlude the opening into the abscess and there should only be holes in the part in the abscess cavity. The wound is left open, except possibly at its lower angle where one or two silkworm-gut stitches taking up the whole abdominal wall may be inserted. Buried sutures are inadmissible here because they are almost sure to become septic and would then be a great source of trouble. The part of the wound not stitched up should have silkworm-gut stitches passed through all the walls and left loose with their ends knotted together so as to be ready for tying as soon as it is possible to diminish the opening. The gauze is usually removed after thirty-six or forty-eight hours and as it is usually firmly adherent to the abdominal coils and the process is very painful it is well to employ an anæsthetic. It is remarkable how seldom any infection of the peritoneal cavity arises in these cases.

Sub-phrenic abscess.—The pus may occasionally travel upwards and form a sub-phrenic abscess or an empyema; this is not so uncommon as

might be thought. A sub-phrenic abscess resulting from appendicitis may occur in various ways. The pus may run up behind the peritoneum and the ascending colon and collect in the cellular tissue beneath the diaphragm; this is most likely to occur when suppuration has occurred behind the cæcum and has infected the cellular tissue. The abscess so formed may point in the lumbar region or it may penetrate the diaphragm and pass into the pleural cavity giving rise to a localised empyema. This mode of spread of the abscess is the rarest.

In other cases, apparently when the tip of the appendix is turned up in front of the ascending colon and almost touches the liver, the pus may extend up in front of the colon and collect between the liver and the diaphragm, and may then perforate the latter and lead to a localised empyema or to adhesion of the lung and be coughed up through the bronchi. Another way in which these sub-phrenic abscesses form is probably by lymphatic infection; in some cases no direct connection whatever can be traced between the abscess beneath the diaphragm and the inflammatory focus in the appendix. Some believe that it always begins as a peri-hepatitis which goes on to suppuration. The size of the cavity and the rapidity with which the symptoms come on vary very much; they may supervene a considerable time after the appendicitis.

The *symptoms* are pain in the lower part of the chest, increase in the liver dulness, friction sounds over the hepatic region, and tenderness; occasionally, when the abscess is foul, gas may be present and may diminish the liver dulness. Diaphragmatic breathing is absent but, unless the pus penetrate the diaphragm, there are no physical signs of pleuritic effusion. The liver is pushed downwards, there is no displacement of the heart, and the condition is fairly easily diagnosed from pleural effusion, but is often confounded with a liver abscess. The latter is, however, rare in connection with appendicitis and in it rigors and sweating are common, while there is usually less interference with the diaphragmatic breathing. In cases of sub-phrenic abscess the diagnosis is made more certain by puncturing the chest with a needle in the ninth intercostal space, somewhere about the mid-axillary line.

Treatment.—The best way to open the abscess is to take out a portion of the tenth or possibly of the ninth and tenth ribs in the mid-axillary line and to get at the abscess below the pleura. If however, on account of the high position of the abscess, it be necessary to open the pleura, the parietal layer should be stitched with catgut to the diaphragmatic layer all round before incising the abscess, and the proposed opening carefully packed off. The needle used for finding the pus is left in the abscess cavity during the manipulations, and is followed as a guide, the diaphragm being incised along it, and dilated with forceps until an opening is made large enough to allow the introduction of a drainage tube (No. 24) which is usually firmly grasped by the diaphragm. A little gauze packing is left around the tube for the first 24 hours so as to shut off the pleura. Should

a localised empyema occur from infection, it may be opened either through the same opening or by a separate incision. The treatment of sub-phrenic abscess from other causes is dealt with elsewhere (see p. 402).

6. **Treatment of a persistent sinus after operation.**—A sinus is not infrequent, and the difficulty in healing may be due to various causes. There may be a concretion, a portion of gangrenous appendix or a septic ligature in the wound acting as a foreign body and, until this escapes, the sinus will not heal; in other cases the appendix remains open and keeps the wound from healing. Another cause of a sinus is a fæcal fistula. In perforative or gangrenous appendicitis or in cases where an abscess has remained for a long time unopened it is not very uncommon for a small perforation in the cæcum to give rise to a fæcal fistula and this may cause much trouble.

The first essential is to make certain that the drainage is efficient and that no foreign body is present. After a reasonable time, the external opening may be dilated very cautiously (because there are often comparatively few adhesions around it) and the cavity searched for a foreign body with a probe, a pair of forceps or even the finger; if preferred, a small scoop may be introduced and the cavity gently cleared out. A large drainage tube is then introduced and the result is watched. When there is a fæcal fistula, gentle irrigation of the wound should be practised through the tube once or twice a day, and efficient drainage must be provided. As a rule these fistulæ close without any trouble and seldom require any plastic operation for their cure.

The sinus may however remain unhealed in spite of good drainage, although no fæcal fistula or foreign body be present; though the sinus in itself may not give the patient trouble, there is always a certain amount of risk about it because the pus may at any time pocket and lead to fresh symptoms, while it is always excessively difficult to maintain a sufficiently free opening in the skin. In these cases, therefore, the question of further procedures has to be considered, and particularly whether, in spite of the sinus, the appendix should be removed. With careful attention to drainage we have seen sinuses of this kind close even after eighteen months, but they are always a source of danger and the question is whether the risk of removing the appendix is so great as to exclude such a means of shortening the case. As a matter of experience it is found that, unless there be free suppuration from the sinus, there is no great risk in removing the appendix with proper precautions. In free suppuration there are of course virulent pyogenic cocci, but in many cases of persistent sinus there is only a slight serous discharge which is probably only feebly infective, and therefore in cases where there has been recurrent trouble with the drainage we are very much inclined, after the lapse of a sufficiently long period,—say eight or ten months,—devoted to attempts to get the sinus to heal, to cut matters short by removing the appendix.

The best way of doing this is not to open up the sinus but to make an independent incision. The sinus should be gently scraped first of all and

packed with a little gauze, partly to define it and partly to get rid of the septic material, and then a separate incision is made in the immediate vicinity to open the general peritoneal cavity and get at the appendix from within. The amount of adhesions met with will of course vary very much, and the surgeon must work from the cæcum and the ileo-cæcal valve to the appendix itself which will usually form part of the wall of the sinus; if firmly adherent to this, the simplest plan is to expose the root of the appendix and divide the peritoneum over it and then to gradually separate the peritoneum from the appendix, shelling out the process from its peritoneal covering. This avoids all risk of injuring the intestine and it is of course the mucous membrane which gives rise to the trouble in healing. If the appendix be not very adherent, it may be separated and removed in the ordinary way. The sinus is now thoroughly cleared out and the abdominal incision is extended into the orifice, which is then packed with gauze, after which the upper part of the wound is closed with stitches. In the course of 24 hours the peritoneal cavity is well shut off, the gauze packing is removed and there is usually no delay in the healing of the sinus.

Plastic operations after drainage of an abscess.—After an appendicitic abscess has been opened and drained a defect must remain in the abdominal wall at the site of the tube and a hernia almost always occurs; the size of the hernia will of course vary with the size of the opening in the abdominal wall. Quite apart from the risk of strangulation, which is of course present, these herniæ are apt to be very painful and hence the question arises as to their repair. Here again we would advise that after some months, when the parts have been more or less restored to the normal, the scar should be excised, the abdominal walls brought together by suture in the usual manner, and in our opinion it is best to take the opportunity of removing the appendix at the same time—a point already referred to (see p. 381).

CHAPTER XXI.

PERITONITIS.

Inflammation of the peritoneum occurs under a variety of conditions and presents several forms. Perhaps the most useful classification from the point of view of treatment is into suppurative and non-suppurative peritonitis, both of which may be either localised or diffuse.

NON-SUPPURATIVE PERITONITIS.

Some authorities assert that peritonitis cannot occur without the intervention of micro-organisms. However that may be, there is no question that it may occur without the intervention of the pyogenic organisms, and it is quite possible that in cases of localised peritonitic exudation no micro-organisms have penetrated into the peritoneal cavity. This pathological question however need not detain us here.

Diffuse non-suppurative peritonitis may occur under various conditions; for instance, *in rheumatic fever* inflammation of the peritoneum may occur just as does inflammation of other serous membranes. It is also said to occur *in syphilis*, and may be met with in the course of *pneumonia* or even possibly in some septic cases without suppuration actually taking place; it may also be of a tuberculous or a cancerous nature. It may also occur *after diffusion of presumably aseptic fluids into the peritoneum*, *e.g.* rupture of an ovarian cyst, although there the proliferating epithelial cells may play an active part; it may also follow rupture of an hydatid cyst.

Treatment.—General non-suppurative peritonitis does not as a rule come under the surgeon, and the only cases to which he is likely to be called are those following rupture of an hydatid or an ovarian cyst. In either of these accidents the sooner the peritoneum is opened, the ruptured cyst removed and the abdomen washed out the better. Rheumatic, syphilitic, or pneumonic peritonitis must be treated on ordinary medical lines. The surgeon not infrequently sees cancerous peritonitis, but of course there is nothing to be done for this beyond tapping the abdomen when

the accumulation of fluid causes marked discomfort; even when there is intestinal obstruction from this cause it is often impossible to relieve the patient. Sometimes a right colotomy may be of benefit, but this depends on the situation and extent of the disease.

Paracentesis abdominis, or tapping the abdomen, is best done under local anæsthesia with the patient in the semi-recumbent position, so that he can lie flat at once if he become faint. The spot selected for puncture is generally the middle line about two inches below the umbilicus, but in any case the puncture must be made into an area from which the bowel, as ascertained by percussion, etc., is absent. The bladder should be emptied before the operation. The skin is purified in the ordinary manner and a few drops of a 5% solution of eucaine should be injected beneath the skin or Schleich's infiltration method (see Part I., p. 123) may be used. With a sharp-pointed curved bistoury a nick is made through the skin and a medium-sized trocar and cannula are thrust rapidly through the abdominal wall. When the trocar is withdrawn a length of sterilised india-rubber tubing is connected with the cannula and the fluid is conducted into a suitable receptacle. Great care must be taken to insure asepsis throughout. If only a moderate-sized trocar be used the fluid escapes so gradually as not to cause the least faintness. As the flow lessens, the sides of the abdomen may be compressed either by the patient himself or by a broad bandage passed round the body. When the flow ceases the tubing is disconnected, the finger is applied over the orifice of the cannula and the instrument withdrawn. The opening is closed by a small pad of cyanide gauze fastened in place with collodion and a firm binder is applied for a few days.

Localised non-suppurative peritonitis is the more frequent form, and we have already referred to various instances in which it may occur. For example it occurs in connection with gastric ulcer and leads to adhesions between the stomach and the neighbouring viscera (see p. 230). It also accompanies appendicitis; indeed, the peritoneal coat of any inflamed viscus is liable to the exudation of lymph and consequently adhesion to neighbouring structures. Similar effusions may occur after an injury that leads to hæmorrhage. The final result of all these cases is the formation of adhesions. We have already referred to the gravity of these in certain cases, and have pointed out that they may compress the organs over which they have formed, *e.g.* the stomach and the intestines, or they may bridge over spaces between coils of intestine, and may thus lead to strangulation of the bowel beneath them, or they may cause intestinal obstruction by kinking. Apart from this, the adhesions may interfere with the proper performance of the functions of the organ, and many cases of abdominal discomfort and obstinate dyspepsia are due to this cause (see p. 283).

It is not always possible to diagnose the presence of adhesions beforehand except by a process of exclusion. In a good many cases the exact state of affairs is only discovered after an exploratory laparotomy, when division and removal of limited adhesions often cures the patient at once.

Treatment.—We need not go into detail as the subject has already been dealt with (see p. 284). When the adhesions are limited, the cure is often permanent; when extensive, the tendency unfortunately is for the adhesions to re-form and the trouble to recur.

SUPPURATIVE OR SEPTIC PERITONITIS.

This affection is much more important and has already been touched upon in connection with rupture of the stomach and intestines and also with appendicitis. Suppurative peritonitis may be localised or diffuse.

LOCALISED SUPPURATIVE PERITONITIS.—We have already dealt with local peritoneal suppuration in connection with the appendix which is the most common example of this form (see p. 375); other examples are localised pelvic peritonitis and inflammations about the stomach or the gall-bladder. The condition necessary for the localisation of the pus is the presence of a plastic peritonitis preceding the actual access of the septic organisms to the part. As a rule the perforation of an organ into a healthy peritoneal cavity leads to a general diffuse peritonitis without any localisation; when it is localised there has been a plastic peritonitis preceding the perforation or infection of the part which has led to adhesions around the point of perforation. The perforation then takes place into the midst of these adhesions and a localised abscess results.

Sub-phrenic abscess.—By this term is meant a localised suppurative peritonitis in the sub-phrenic region; the latter is divided into two parts by the suspensory ligament of the liver, so that the sub-phrenic abscess may be on the right or the left of this structure. The abscesses to the right of the ligament usually occur in connection with appendicitis, with suppurations about the right kidney, and possibly with right-sided empyema. They may also follow suppurations in the gall-bladder and possibly in the liver itself, although this is very rare. As a rule an abscess in the upper part of the liver will perforate the diaphragm and the pus will find its way directly into the pleural cavity or the lung and not into the peritoneal cavity above the liver. Sub-phrenic abscesses to the left of the suspensory ligament originate most commonly in connection with perforation of the stomach. They may also arise from trouble in connection with the duodenum, the left kidney or the spleen, or from a suppurating hydatid cyst.

A sub-phrenic abscess may be intra- or extra-peritoneal; those which occur in connection with perinephric suppuration are extra-peritoneal, the pus finding its way up behind the peritoneum; we have already referred to some forms occurring in connection with the appendix which are extra-peritoneal (see p. 396), while in the rare cases in which an empyema makes its way through the diaphragm the abscesses are also extra-peritoneal. In the great majority of cases however the true sub-phrenic abscess is intra-peritoneal. Thus, in perforation of the stomach there is first a plastic peri-

tonitis leading to adhesions which shut off from the general peritoneum a cavity into which perforation followed by suppuration takes place.

Symptoms.—The symptoms are very variable and depend on the source of the suppuration. We have already referred to the chief symptoms of sub-phrenic abscess after appendicitis (see p. 396) and of the localised suppurations in connection with the stomach. The abscesses sometimes come on quite insidiously. There is usually a certain amount of fever, loss of appetite and wasting and more or less tenderness on pressure over the lower ribs. The liver is pushed down without being enlarged and the diaphragm is pushed upwards. If there be gas-formation in the abscess, or if it communicate with a hollow viscus, the gas accumulates towards the upper part and leads to obliteration of the liver dulness. This is not absolutely pathognomonic but, taken in association with other symptoms, it will help the diagnosis. When gas is present in the abscess there is also succussion. The exact situation in which these abscesses point will also vary.

Treatment.—The sooner the abscess is opened the better. The incision will vary according to circumstances, but the object is to evacuate it freely and not to infect the general peritoneal cavity in so doing.

In a *right-sided sub-phrenic abscess* the most suitable incision is that already recommended for an abscess originating in connection with appendicitis (see p. 396). Sub-phrenic abscesses originating in connection with the stomach or with hydatid cysts often point in the epigastric region and then the best plan is to make the incision over the upper part of the swelling there so as not to risk dividing any adhesions; should any part be tympanitic, that is sure to be inside the area of the adhesions. An opening in this position is not the best for drainage, but it is very convenient for examining the character and connections of the abscess.

When the abscess is limited in the epigastric region and points forwards, it is sufficient to introduce a drainage tube into the epigastric wound; but when it burrows to the left lumbar region, as it often does, a counter-opening should be made; this will probably go through about the ninth intercostal space, and care must be taken either to go below the pleural reflection, or, if the healthy pleura has to be opened, to stitch the diaphragmatic and the costal surfaces of the pleura together so as to shut off the pleural cavity before the counter-opening is made (see p. 396). In some cases the counter-opening will be in the lumbar region.

When a sub-phrenic abscess occurs in connection with a perforation of the stomach or intestine, the question of dealing with the hole in the viscus arises. In the great majority of cases the hole closes *pari passu* with the abscess, and a permanent fistula is very infrequent. If the perforation be immediately within reach, an attempt may be made to stitch it up, but as a rule the stitches will not hold; they interfere with healing afterwards, and very often have to be removed, so that the proccdure is hardly worth while.

ACUTE GENERAL SUPPURATIVE PERITONITIS.—This is one of the most terrible, and, from the point of view of treatment, one

of the most disheartening conditions that can be met with. It usually arises in connection with the perforation of a viscus such as the stomach, the intestine, or the appendix. It may follow rupture of a localised collection of pus in the Fallopian tubes or elsewhere, perforation of a septic gall-bladder, or extravasation of septic urine; it may, of course, follow operations in which septic material has been introduced. In idiopathic cases—*i.e.* those occurring without operation and without evidence of rupture of a viscus—the most common cause is appendicitis, but in the female a very frequent one also is tubal sepsis. It is well to bear these two causes in mind, because any attempt to cure the condition must go to the root of the trouble as well.

Pathology.—The micro-organisms at work in these cases vary considerably, and the type of the peritonitis apparently varies also according to their nature and virulence. The bacillus coli communis by itself seems to be a not uncommon cause of septic peritonitis; perhaps associated with it or more commonly alone are the various pyogenic organisms of which the most fatal are the streptococci which give rise to the rapidly fatal adynamic form of the disease. The gonococcus also may lead to general septic peritonitis, although this is not so virulent a form as the others, and the attack may be recovered from. Septic peritonitis may also occur in connection with the bacillus of pneumonia and possibly also in connection with other organisms.

Symptoms.—The condition is usually easily diagnosed, and a mistake is comparatively seldom made, although the symptoms vary very much according to the suddenness of the onset and the virulence of the condition. Apart from the symptoms due to rupture of a viscus, such as the stomach or intestine, which we have already referred to, or of the appendix, there are the symptoms special to the peritoneal inflammation. In the less severe cases, the shock of the perforation is recovered from and then various phenomena set in, the most prominent of which is vomiting; this is very persistent and occurs without an effort on the part of the patient who constantly brings up a mouthful or two of the stomach contents or of bile; the quantity of fluid that the patient can bring up in these cases is quite surprising. The so-called fæcal vomiting is not a feature of septic peritonitis. The pain is variable; sometimes it is so intense that the patient cannot bear the slightest touch, nor can he take a deep breath, while at others it is not marked. Some tenderness is always present. Distension of the abdomen is a very constant feature when the affection is well developed and is due to the inflation of the intestines with gas. Another constant feature is constipation, although in the early stages excessive diarrhœa may be present; in the late stages of peritonitis the bowels seem to be paralysed and peristaltic action is absent. The temperature varies; unless the disease be very virulent, it usually rises in the first instance, and then gradually falls as the patient becomes more profoundly poisoned; in other cases there may be no rise of temperature at all, the patient dying from poisoning.

Perhaps the best criterion as to the condition of the patient is the pulse. Increasing rapidity and smallness of the pulse are very grave symptoms; it may run up to 130 very soon after the attack has commenced. A rigor may or may not occur. The patient generally feels desperately ill, and has the typical drawn, sunken, anxious face associated with severe abdominal inflammations, the so-called abdominal aspect or facies Hippocratica. The face is of an earthen colour, and the lips are cold and bluish. The patient is usually restless, the respirations are entirely thoracic, there is great rigidity of the abdomen, which, however, is gradually overcome as the latter becomes distended. The intellect is usually unimpaired. The patient gives one the impression that he is being profoundly poisoned.

Treatment.—The treatment of these cases of septic peritonitis is most discouraging, and the great majority end fatally whatever is done.

Medical.—In quite the early stages, while the patient is still pretty strong and before it is evident that there is suppuration in the abdomen, medical measures may be employed. The patient should be kept in the recumbent position with the legs flexed over a pillow and a cradle over the abdomen to take off the weight of the bed-clothes. The *food* should be entirely fluid, of a highly nutritious character and for the most part peptonised. Digestion is very feeble, and there is little absorption from the alimentary canal. Up to the period when vomiting sets in however small quantities of food may be given by the mouth, but, as soon as this occurs, recourse must be had to rectal feeding (see p. 234). Thirst is always very marked, and is best overcome by one or two large normal saline enemata; a large quantity may be introduced in the hope that an action of the bowels may also be produced or, if not, that the fluid may be absorbed. When the vomiting is severe, relief may be obtained by washing out the stomach from time to time, while the distension may be relieved by a long flatus-tube.

Of late years attempts to promote the action of the bowels by *saline aperients* have been advocated, and no doubt much benefit may be derived from it in the early stages. It is questionable whether this plan should be adopted in cases of idiopathic peritonitis, but when laparotomy is followed by symptoms of peritoneal inflammation it is one of the earliest things that should be resorted to; a drachm of sulphate of magnesia every two or three hours, followed by a large enema, will at any rate cause a large quantity of fluid to be passed, and this is presumably drained away from the peritoneum; at any rate there is no doubt that symptoms of septic peritonitis after operation have disappeared after a free action of the bowels produced in this way.

The employment of purgatives in the treatment of true suppurative peritonitis does not seem to us to be advisable. To employ saline purgatives after vomiting sets in seems to be not only useless but actually dangerous; by that time the possibility of promoting peristaltic action is very slight, and the only result of a purgative, provided it be kept

down, will be to increase the amount of fluid in the intestines and to proportionately add to the patient's distress. Any attempt to obtain an action of the bowels in these advanced cases must be by large soap and water enemata, which very often are not returned, in which case they serve to allay thirst. A drachm of turpentine may be added to each enema, but the chance of obtaining any satisfactory result is very slight, and the patient should not be unduly distressed by persisting with them.

A somewhat disputed point is the administration of *opium*. When the pain is very intense it will be essential, but it should be restricted to the smallest possible doses, and should be given in the form of morphine. It used to be held that opium gave valuable rest to the intestines; as a matter of fact the intestines are very soon immobilised by the inflammation, and opium only increases the paralytic condition without any corresponding advantage. *Strychnine* and *digitaline* are valuable in keeping up the pulse. Inhalations of *oxygen* may be useful when the patient is getting blue; they will have to be practically continuous.

Among local applications, a *Leiter's coil*, provided the patient can bear its weight, will probably do good in the early stages, although more comfort is generally experienced by the employment of *hot fomentations*; it is perhaps best to consult the patient's feelings in the matter.

Operative.—This is the great question for consideration. We are here faced by the question as to whether it is possible to do any good by operation. Operative interference must aim primarily at removing all the septic material in the peritoneal cavity, so as to put a stop to the process. At the same time of course there will be a second object, viz., to treat the primary cause of the peritonitis, because to wash out the peritoneal cavity and to leave a perforation in a viscus unclosed, is not likely to do good. As a matter of fact, although a few cases have recovered after washing out the peritoneal cavity, by far the greater number have died; while some authors put recoveries at perhaps one or two per cent. only, others take a much more rosy view and put them much higher.

It is highly probable that many of the cases of recovery are really cases of more or less local peritonitis, and our own experience of the true diffuse form corresponds with that of those who consider that the results are exceedingly unsatisfactory and very depressing. To assert that, when called to a case of this kind, the only thing to do is to open and wash out the abdomen is hardly in our opinion correct. Much will depend on the condition of the patient and on the local character of the trouble. If the patient has been ill for some time, if the abdomen is much distended, the pulse rapid and very feeble, and the general condition altogether very bad, an efficient washing out of the abdomen is quite out of the question, and will only precipitate the fatal event and remove any possible chance of recovery the patient may have. We are coming round to the opinion that the advanced cases are for the most part best left alone. The abdomen

is much distended and, if any opening be made large enough to efficiently wash out the abdomen, the intestines are sure to escape freely; their manipulation is accompanied by great shock, and it is extremely difficult to get them back again. The only cases which are at all suited for operation are the comparatively early ones without great distension or profound poisoning, In them we certainly think that the patient should have the chance of operation without delay.

The extent and character of the operation will vary with what is found on opening the abdomen; the conditions which are met with are very various. In some cases, even the worst, there may be comparatively little pus or lymph, and the case is rather a general peritoneal septicæmia than a suppurative condition. Under such circumstances the abdominal cavity should be flushed with large quantities of hot salt solution through a comparatively small opening in the middle line. The abdomen cannot be satisfactorily cleansed through a lateral incision, and, if the appendix or some lateral organ requires to be dealt with, a second opening may be afterwards made over it.

The object of the operation is to remove the pus and exudation from the general abdominal cavity, and in all cases therefore we begin with an incision in the middle line usually somewhat below the umbilicus; should no fluid be found in the general peritoneal cavity, this may be closed and a second incision made over the appendix. These cases are much more favourable, as they are semi-localised forms; their treatment has already been described (see p. 392). As a rule, however, a general peritonitis is evident on making a median incision; either the peritoneal cavity is full of muddy, semi-purulent fluid without any great exudation of lymph and adhesions of the intestines, or coils of intestine are matted together by large masses of lymph, and on separating the former pus is found in all directions. The latter cases are extremely unfavourable, because, however carefully one separates the coils and washes out the abdomen, there are almost certainly numerous collections of pus between the coils which must escape evacuation and which render the operation useless. In these almost hopeless cases the question of evisceration (see p. 304) will arise, but the patients are usually so ill that they cannot possibly stand such a severe procedure and, even with it, the chances of eradicating the disease are very slight. The lymph is adherent and difficult to peel off the intestines and is full of infective micro-organisms, so that without its removal it is impossible to cleanse the abdomen effectually; moreover, the difficulty of getting the distended intestines back is very great, and indeed is often insuperable, while the shock caused by trying to do so will probably prove fatal.

Hence, if on opening the abdominal cavity this condition be found, the incision may either be closed at once or glass tubes may be passed down to Douglas's pouch and the lumbar regions, which are washed out, taking care not to tear the fragile intestines in doing so. A small perforation may

then be made in the loins for drainage, and a tube introduced into Douglas's pouch. But the prognosis is very bad.

On the other hand, if a quantity of thin turbid fluid be found, without any marked matting of the intestines, the chances of cleansing the abdomen are much greater, and here the question arises whether the surgeon should be content to wash out the abdomen through a comparatively small incision or whether he should eviscerate the patient and thoroughly cleanse all the coils and the fossæ in the peritoneum. The latter course is much more effectual and, when there is very little lymph, it is a much more hopeful procedure, provided always the patient is able to stand it. If irrigation and drainage alone be employed it must be very thorough to be effectual. At the same time *evisceration* is such a serious addition to the shock that it can only be employed in very favourable cases. In the majority of instances the surgeon must be content with thorough irrigation, and a certain number of cases have recovered after washing out of the abdomen. These cases and those in which the peritonitis has not become diffuse over the abdomen are no doubt responsible for the more favourable view which some surgeons take as to the value of surgical intervention in cases of septic peritonitis.

If *irrigation without evisceration* be decided upon, it must be as thorough as possible, and is best effected if two or three openings be made into the abdomen. If the peritonitis be due to appendicitis a small incision should be made over the appendix and that organ removed. It is well before commencing irrigation to make a small incision in each flank and introduce a large-sized drainage tube with numerous holes; these are the chief places where the fluid accumulates, and the incisions are valuable in facilitating irrigation and for drainage afterwards. The abdomen is now irrigated through the central incision most thoroughly. A long tube is first passed into the appendix region and the fluid is allowed to escape, partly by the tube there and partly through that in the loin. The tube is then passed into Douglas's pouch, which must be very thoroughly flushed, after which it is directed into both iliac fossæ and then both lumbar regions. This irrigation should be continued as long as the patient does not show signs of failing, and several quarts of hot salt solution (105° F.) should be used. Finally, drainage tubes should be introduced into the lumbar and appendix wounds, and a large glass drainage tube, with a gauze wick in its interior to favour the escape of the fluid by capillary action, through the central incision into Douglas's pouch.

A point in these operations to which we attach importance is that in our opinion the surgeon ought to wear india-rubber gloves. We do not advocate them as a general rule, but we certainly think that the operator ought to wear them in this operation not so much for his own sake as for that of the patients upon whom he may have to operate subsequently. The fluid is excessively virulent and, apart from the fact that the surgeon may infect himself, the septic material is apt to hang about the nails and the

cracks in the hands and, even after a thorough washing, the septic organisms may be conveyed to another patient, especially if a second operation be done soon after the first. We should certainly not feel comfortable in performing a second operation a few hours after operating on one of these cases, even after the most thorough purification.

TUBERCULOUS PERITONITIS.

This is by no means an uncommon form of tuberculosis and is usually secondary to phthisis, tuberculous disease of bones, joints, or glands, genito-urinary tuberculosis, or tuberculous ulceration of the intestine. Primary tuberculosis of the peritoneum is comparatively rare.

CAUSES.—Among the intra-abdominal diseases giving rise to tuberculous peritonitis the chief are tuberculous ulceration of the intestine —including tuberculous appendicitis,—tuberculous mesenteric glands and tuberculous disease of the genito-urinary system, especially of the Fallopian tubes. Many authors look on intestinal ulcers as among the most common causes of tuberculous peritonitis. The tubercles forming the base of the intestinal ulcer gradually infiltrate the bowel until they reach the sub-serous coat, and then rapid infection of the peritoneum, at first local and then general, follows. The form associated with intestinal ulceration is usually extremely serious, and there is generally extensive caseation and secondary deposits in the peritoneum. Perforation may occur and suppuration, sometimes however localised, followed by a fæcal fistula when the abscess is opened.

Tuberculous disease of the intestine is said to occur most commonly in the lower part of the ileum, but it is also very frequent in the cæcum. Tuberculous appendicitis is also met with, but not so often as one would expect. Other common starting-points of infection are the female generative organs, more especially the Fallopian tubes, which become enlarged, hard and tortuous and form thick sausage-shaped masses full of cheesy material or broken-down pus with their walls dotted with tubercles. The tubes usually become firmly adherent to the uterus and rectum. The disease in the tubes almost always commences close to the fimbriated extremities, and the canal is quickly shut off from the peritoneum by firm fibrous adhesions.

Tuberculous mesenteric or retro-peritoneal glands are the least common of the three sources of infection, and the enlargement of the mesenteric glands that is seen so commonly in tuberculous peritonitis is part and parcel of the disease rather than a preceding event.

VARIETIES.—The results of the tuberculous infection of the peritoneum differ widely, and the conditions found may be divided into three main groups; these groups are however quite arbitrary, and there is no hard and fast line of separation between each.

1. The peritoneum is studded with tubercles, some small, greyish and transparent, others large and becoming cheesy. They are scattered over both visceral and parietal peritoneum and frequently have patches of fibrinous

exudation over them; in the early stage there is not necessarily any matting of the intestines or distortion of the omentum or mesentery. There is almost always some fluid in the abdominal cavity, usually of a lightish straw colour or opalescent or even blood-stained. The sensation on putting one's finger into an abdomen thus affected is the same as if it were passed into a bag of sago. The tubercles generally occur in patches, and are most marked in the vicinity of the primary lesion. Although matting together of the intestines is not a feature of the disease at this early stage, they may be stuck together to a certain extent, and thus the fluid in the abdomen does not pass freely from one part of the cavity to the other and may even be collected together in parts and simulate a cyst.

2. In a second group, adhesions of the intestines and fibroid induration of the omentum and mesentery are the marked features. The intestines become bound together by firm new fibrous tissue in which miliary tubercles are present, and these adhesions may constrict the intestine or may cause kinking and lead to obstruction. The intestines are adherent not merely to one another but also to the abdominal wall; this is a cause of anxiety in performing laparotomy in these cases and is the chief objection to aspirating the abdomen for the removal of fluid. When the entire abdomen is affected, the adhesions are most marked near the diaphragm. The omentum is early involved; its layers become matted together and the whole structure becomes thickened and shrunken and, in the advanced stages, forms a thick sausage-like mass lying more or less transversely about the level of the umbilicus. It is generally adherent to the abdominal wall at this point. The omentum contains numerous tubercles in its substance and scattered over its surface, while the mesentery is thickened and shrunken and drags the small intestine up towards its root so that, when fluid is present, it generally collects towards the left side of the abdomen. The mesenteric glands are also enlarged though not as a rule cheesy. The spleen is not uncommonly enlarged and encapsuled collections of fluid are quite common.

3. In the third group, a very grave one, the tuberculous masses are much larger and are undergoing caseation. The mesenteric glands are large and caseous, the omentum is often converted into a caseating mass and similar masses form in the adhesions which bind the intestines together. The contraction and distortion of the bowel, the shrinking of the mesentery and the other changes mentioned under the second form (*vide supra*) are much exaggerated. This condition is usually associated with ulceration of the intestine, which is thinned and may even be perforated in places, while in others several strictures, some of them quite tight, may be present and may cause incomplete obstruction. Collections of fluid are not uncommon; they are usually encapsuled and generally purulent, the pus presenting all the characters of ordinary tuberculous pus. In some cases however the latter is foul and contains the bacillus coli communis either from infection through the intestinal walls or from actual perforation of the intestine. In young children this condition is most marked near the umbilicus, through

which pus may find its way; it is not uncommon to find an umbilical sinus and even a fæcal fistula as well. As the latter is usually in the small intestine, often high up, the child rapidly emaciates and goes downhill.

The above are the chief types of tuberculous peritonitis, but intermediate varieties are met with. The affection may be localised, especially in connection with tuberculous perityphlitis or disease of the tubes, and the mass thus formed has frequently been mistaken for a tumour; in the cæcal region such masses give rise to more or less complete obstruction.

The affection may occur at any age but is most common between twenty and thirty-five; it is common in children but comparatively rare above thirty-five. Differences of opinion exist as to the relative frequency in the two sexes, but females seem to be much more frequently operated on for the disease than males.

SYMPTOMS.—The disease is not easy to diagnose in the early stages. It may begin slowly and insidiously or it may be rapid and quite readily mistaken for typhoid fever or tuberculous meningitis. As a rule the following are the chief points. The patient complains of malaise, headache, thirst, does not sleep well and suffers from night-sweats. He soon loses his appetite, and not uncommonly has occasional vomiting. The bowels are irregular and he suffers either from constipation or diarrhœa or from alternations of the two. Next follows abdominal pain increased by exertion or it may be only a feeling of weight or pressure; sometimes there is no pain, and it is rare for pain to be marked at the commencement of the disease. There is generally an evening rise of temperature, but it may not be marked; in some cases there is none. In others again the temperature after being normal for a considerable time may suddenly rise in the evening and assume a hectic type. In all except the acute cases the patients are able to get about in the early stages, but from time to time they may have to lie up on account of general weakness or of increasing pain. After some weeks or months however the patient has to give up work either on account of increasing weakness or more commonly because of gradual swelling of the abdomen, severe pain or shortness of breath. As the disease goes on, there is a rapid advance in the mal-nutrition and emaciation, the skin becomes pale, sallow and dry, the cheeks sink in and the patient acquires the suffering aspect of those with abdominal trouble. In some cases the symptoms are much more acute and in a considerable number they may be mistaken for those of typhoid fever.

The local conditions found on palpating the abdomen depend on the pathological changes already described and to a great extent also on whether there is or is not fluid free in the abdomen. When such is the case, the abdominal wall is very tense and shiny with big veins running over it and the lower ribs are everted. When there is little fluid, the thickened omentum is easily felt as a sausage-shaped mass running transversely across the abdomen about the level of the umbilicus. The percussion note is variable; fluctuation is indistinct and the fluid changes its position slowly,

as it has to make its way among the adherent intestines. Sometimes the fluid may be encapsuled and form soft tumours often mistaken for ovarian cysts. Again there may be little fluid present; the intestinal coils become adherent, the mesentery contracts, the omentum is thickened and shrunken, and hard masses are formed in the abdomen. The coils are irregularly distended with gas, there may be marked meteorism and, when there is partial obstruction, the coils of the intestine may be seen through the abdominal wall. The splenic dulness may be increased, the liver dulness is not uncommonly diminished and the stools are light in colour from imperfect digestion of fat.

The disease is often associated with various *complications*, more especially intestinal obstruction due to kinking, to bands, or to stricture following ulceration. Perforation may also occur either through an ulcer or from obstruction; or there may be abscess formation with discharge of pus from the umbilicus and fæcal fistula. It is not uncommon for the disease to be complicated with phthisis or pleurisy.

The *diagnosis* is not always easy. The affection has to be distinguished from ulcer of the intestine, malignant disease, gastric catarrh, typhoid fever, peritoneal cancer, chronic peritonitis from other causes and ovarian cysts. The points in favour of tuberculous peritonitis are a family history of tuberculosis, tubercle elsewhere, the presence of localised atypical thickenings in the abdomen, a fairly rapid formation of exudation, a feeling of weight and uneasiness, an atypical percussion note changing very slowly with alterations in position, the presence of little or no fever or a hectic temperature, little or no albuminuria, and no demonstrable cause for the ascites.

The *prognosis* is undoubtedly very grave, but much depends on the form of the disease and on the presence or absence of complications. As a matter of fact, physicians now take a much more hopeful view of the trouble than they did and, provided that no complication such as phthisis, obstruction, or perforation arises, the outlook, especially in the young, is now considered not nearly as bad as was formerly held to be the case.

TREATMENT.—This is partly medical and partly surgical; in the early stage the treatment lies with the physician.

Medical.—The patient should be placed under the best hygienic conditions; the diet must be highly nutritious and digestible. In the later stages, especially when there is intestinal ulceration, it must be entirely fluid. The bowels should be regulated; if ascites be present, diuretics will also be called for. Cod-liver oil may be given either by the mouth or by the rectum, and arsenic is of use. Intestinal antiseptics, such as creosote, salol or guaiacol may also be employed. Dr. Burney Yeo speaks highly of abdominal inunction with iodoform ointment and the internal administration of iodoform in the form of one-grain pills three times a day. When pain is very marked, the local application of belladonna to the abdomen or a subcutaneous injection of morphine may be desirable. Ice has also been applied to the abdomen with benefit.

Surgical.—Up to comparatively recently surgical interference was not thought of unless some complication occurred and this is to some extent the case even now. Surgical intervention however must be considered from various points of view. It has been found in a number of cases, where the abdomen has been opened for diagnostic purposes or under a mistaken diagnosis as to the nature of a swelling, that the condition was one of tuberculous peritonitis, but that nevertheless the tuberculous condition has rapidly improved after the operation although nothing was done beyond opening the abdomen; this has occurred so frequently that of late years simple laparotomy in cases which do not yield to medical treatment has come very much into vogue. Thus, probably the chief surgical measure in progressive cases is a simple laparotomy.

Surgical intervention may however be called for when there is intestinal obstruction, or a collection of purulent fluid, or with the object of extirpating a localised tuberculosis; in these last cases however the diagnosis is comparatively rarely made. Again, surgical intervention may be required for the cure of a fæcal fistula.

Simple laparotomy.—The results of a simple laparotomy for tuberculous peritonitis vary very considerably according to the type of disease present, but all types may improve after it. The greatest improvement is evident when there is free fluid in the abdominal cavity, but improvement also occurs in cases where little or no fluid is present; even in the bad caseating cases a few, though by no means the majority, may improve. How laparotomy acts is unknown; it suffices to say that it simply aims at opening the abdomen and evacuating any fluid present.

The cases most suited for operation are those belonging to the first group, especially if the pathological changes be localised, and the next most favourable are those where the fluid is diffused over the abdomen. In the third group (see p. 409) the successes are few and the operation is difficult; indeed a fæcal fistula may result even without apparent injury to the intestine. It is also not uncommon for the scar to become infected with tubercle; but, even in spite of this, benefit may ultimately occur, while practically all the patients die if left alone, so that no one of the classes can be quite excluded from operation. But the frequency with which operation will be resorted to differs in different cases; in those with effusion it will be readily resorted to, in others less quickly, and in the caseating form only as a last resort. Phthisis does not seem to be a bar to the operation which, when not accompanied by excision of portions of the abdominal contents, is not accompanied by shock; the condition of the lungs has been found to improve *pari passu* with the local condition in cases that have benefited by operation.

Most suitable time for operation.—Unless improvement follows medicinal treatment within six weeks in acute cases or six months in chronic ones, the abdomen should be opened whether fluid be present or not. The operation may do good when it is least expected to do so and in any case the patient

should not be allowed to go too much downhill. On the other hand, it apparently does not do to operate too soon; curiously enough, operation in quite the early stage is very apt to be followed by recurrence. If the patient be suffering from incomplete obstruction, the abdomen should be opened early with the view of performing a short circuit operation, or even, if possible, of removing the affected portion of the intestine or other primary seat of the disease.

Operation.—An opening is made in the middle line of the abdomen below the umbilicus, any fluid is allowed to run out, its escape being aided by turning the patient on the side, and then the wound is stitched up again. Formerly the abdomen was washed out with various antiseptics such as carbolic acid or sublimate lotions, or was flushed with salt solution and carefully dried with sponges. All these methods seem quite unnecessary, as equally good results are obtained after simple laparotomy. When adhesions are present, great care is necessary in opening the abdomen to avoid injury to the intestine and, if the adhesions be firm and numerous, it is better to abandon the operation and close the wound than to force a way in among the intestinal coils; the bowel is usually very fragile, and any attempt to separate adherent coils may lead to actual laceration of the intestine at the time or may so injure its wall as to lead to a fæcal fistula subsequently. When pus is found, it should be washed out by salt solution, and some iodoform and glycerine emulsion should be introduced into the cavity before closing it.

Various important points have to be considered in connection with the operation, the first of which is the question of drainage when fluid is present. There seems to be no advantage in this when the fluid is serous; indeed it may lead to a tuberculous sinus. Even when pus is present, provided it be not foul or apparently infected, it is well to treat it like a chronic abscess elsewhere, washing out the cavity and leaving in iodoform and glycerine (see Part I., p. 248); if the pus be infected with pyogenic organisms, drainage must of course be provided.

Another important question is whether the primary focus (see p. 408) should be searched for and removed. Much will depend on the condition of the patient and the extent of the disease in the peritoneum. Theoretically of course the primary focus should be removed and practically it has been found that, in suitable cases seen early, the best results have followed this practice. On the other hand, the disease is very extensive in the majority of cases to which the surgeon is called and the question becomes much more complex. As a result of what has been done in this way we would formulate the following opinion:—When the tuberculous disease is strictly localised to the neighbourhood of the primary focus,—*e.g.* when only a few coils are affected in the neighbourhood of an intestinal ulcer, when only the cæcum and the neighbouring parts of the ileum are affected in cases of tuberculous appendicitis, or when there is only a commencing eruption of tubercles about the Fallopian tubes without any extensive matting of the intestine,—we think

that without doubt the primary focus should be removed, provided the patient's strength be good, whether it involves resection of the intestine, removal of the appendix or of the Fallopian tubes; the results obtained are certainly far better than those of simple laparotomy. On the other hand, in the much more advanced cases, adhesions are present and it is excessively difficult in the first place to find the primary focus and in the second to remove it when found. Here also the patient is generally run down and cannot stand a prolonged operation; moreover, the tuberculous intestines are so fragile that they tear very readily and a fæcal fistula or a fatal perforation may follow the attempt. We therefore recommend that in advanced cases it is better to be content with a simple laparotomy unless the primary focus be quite readily removable.

Laparotomy for obstruction.—Another reason for surgical intervention is intestinal obstruction (see p. 351). The surgeon must judge when the abdomen is opened how far the condition can be remedied either by resection of the infected portion of the intestine (which however can only be seldom practicable) or by an anastomosis of healthy bowel above and below the seat of obstruction. A remarkable case of recovery after a short-circuit operation done for almost complete occlusion of the intestine has come under our care and similar cases have occurred in the practice of others.[1] We would therefore advise that, in all cases where symptoms of grave obstruction are present, the abdomen should be opened and a short-circuit operation should be done if possible. When this is impossible, the abdomen must be closed again in the hope that the simple laparotomy will lead to improvement.

Mr. Mayo Robson[2] has suggested that a short-circuit operation should be done for tuberculous ulceration of the intestine not only to avoid obstruction but also to give rest to the affected portion of the bowel. This is no doubt theoretically quite good, and practically it has been found that, when operation has been performed for incomplete obstruction, great improvement has followed in the majority of cases, showing the value of rest to the affected coil. In practice however the surgeon will not as a rule see the cases until the tuberculous peritonitis has lasted some time or until, in the case of pure intestinal tuberculosis, the gut has become narrowed and symptoms of obstruction are present, and as a matter of fact there were symptoms of commencing stricture before operation in Mr. Mayo Robson's cases. It does not seem very probable that there is much of a future for short-circuit operations in intestinal tuberculosis apart from obstruction. The extent of the mischief is very variable and a very large portion of the alimentary canal may have to be shut out and, unless there be marked obstruction, the operation will not give complete rest to the intestine as a large portion of the contents will still pass through the ulcerated portion.

[1] See *Lancet*, January 12th, 1902.

[2] See Report of Clinical Society, *British Medical Journal*, January 12th, 1902.

Treatment of fæcal fistula.—Another condition for which the surgeon is called in is a fæcal fistula. Here operation is practically hopeless; suppuration followed by fæcal fistula occurs especially in the very bad caseating forms in which the intestine is not in a fit condition for repair; generally also the patient is in a very low state of health and the chances are probably equally good if he be left alone.

TUMOURS OF THE PERITONEUM.

CANCER.—Malignant disease of the peritoneum may take the form of acute peritoneal cancer, as after cancer of the bowel, and for it nothing surgical can be done. Multiple melanotic sarcomata may be met with, chiefly in the glands, and here again nothing can be done.

CYSTS.—Various cysts occur in the omentum and the mesentery. Sometimes they are secondary to ovarian cysts, probably following an infection from a ruptured ovarian cyst; sometimes they apparently originate in connection with lymphatic vessels and may even contain chyle. In other cases again their origin is quite obscure; cysts, sometimes of large size, containing clear fluid may be met with in the mesentery.

Hydatid cysts are not very uncommon in the omentum or mesentery, and extra-peritoneal cysts have also been found in connection with the urachus. We have also met with two or three examples of a curious form of cyst known as the blood cyst in the abdominal cavity, the exact origin of which is not very clear. Often there is a history of injury and it may be a breaking-down hæmatoma. The fluid is blood-stained, and the patient, who is generally decidedly ill, is very much relieved on the evacuation of the cyst, and very often recovers quite well.

Treatment.—The true nature of these cysts is generally diagnosed only when the abdomen is opened; they are generally mistaken for ovarian or renal tumours. The cyst must either be excised or drained; in omental cysts excision is possible, but it is much less easy in mesenteric cysts, and is really only possible in quite small ones. However, the results seem quite satisfactory when the cyst wall is stitched to the parietal peritoneum and then opened and drained. The best plan is to unite the cyst wall to the edges of the parietal peritoneum by a continuous suture, leaving exposed a surface sufficient for the insertion of a drainage tube: an aspirating needle is then introduced into the cyst, and the greater part of its contents drawn off. This is done to avoid the possibility of the contents escaping into the peritoneal cavity. An incision is next made into the cyst and a large-sized drainage tube introduced. Should the cyst be hydatid the daughter cysts should be evacuated before the drainage tube is put in, and the opening will need to be large.

LIPOMA.—Fatty tumours of the omentum or retro-peritoneal tissues have been removed, but they are very rare and do not call for special mention.

CHAPTER XXII.

HERNIA: GENERAL CONSIDERATIONS.

By the term hernia is meant the protrusion of a viscus through the wall of its containing cavity and this may occur either through dilated natural openings or through spots weakened by some antecedent inflammation. We shall here deal only with abdominal herniæ.

ANATOMICAL CHARACTERS.—A hernia that has not passed through the whole thickness of the abdominal wall is spoken of as an incomplete hernia; when it has, it is called a complete one.

The constituents of a hernia.—A hernia is made up of a hernial sac, its contents and its coverings.

The great majority of herniæ possess a sac formed from the peritoneum, but a few are without this; among the latter are some herniæ of the cæcum and the bladder, but they are quite exceptional. The sac may either exist previous to the descent of the hernia or it may accompany it. An example of the former condition is the open funicular process in congenital inguinal hernia where the contents are covered by a sac which is not formed by peritoneum pushed down before the advancing hernia, as it is in all the acquired cases. The sac is thin except in long-standing cases, in which it may be much thickened; any changes present are most marked at its neck, which may be rigid and narrow instead of being distensible. Sometimes the fundus of the sac shows constrictions, but the probable explanation here is that the original thickened neck has been pushed down and a new one formed; this will account for many of the "hour-glass constrictions" of the sac. In operating for strangulated hernia it is important not to divide a constriction of this kind under the impression that it is the true neck of the sac.

Occasionally a double sac, or rather a diverticulum from the main sac, is met with and after herniotomy the contents of the lower portion of the sac may be reduced into the upper portion instead of into the abdomen and the strangulation is thus left unrelieved.

A hernial sac once formed is not reducible; when a hernia is reduced

the contents only are returned into the abdomen leaving the sac lying in the canal.

The coverings of the sac consist of the structures superficial to the aperture through which the hernia passes and are fully described in anatomical text-books. As a matter of practice it is often impossible to distinguish the various coverings, especially in strangulated hernia. In an inguinal hernia it is easy to recognise the external spermatic and the cremasteric fascia, but the other coverings are usually indistinguishable, while in femoral hernia the various layers are much more difficult to differentiate. The sac is recognised after all the superficial structures have been peeled off by its thin transparent appearance; it possesses no large vessels and if these be seen after the sac has presumably been cleared it is certain that all the coverings have not been removed.

Most of the abdominal viscera have been found in hernial sacs; the most common are portions of the small intestine, the omentum or, perhaps more commonly still, both together. Other organs not infrequently found in the sac are the large intestine, especially on the left side, the cæcum with or without a sac, the appendix or the ovary. Various important changes take place in the contents which will be considered in connection with irreducible hernia.

CAUSES.—The causation of hernia is a much debated subject, which we need not enter into as it does not affect treatment. The principal causes are predisposing and exciting. The chief **predisposing causes** are heredity, occupations entailing constant exertion in positions that leave the weaker portions of the abdomen unprotected, feeble abdominal muscles from faulty nutrition or debilitating illnesses, imperfect development, the distension of pregnancy, constant cough, marked straining—as in stricture of the bowel or urethra, phimosis or enlarged prostate,—imperfect closure of the funicular process of the peritoneum, various inflammatory affections of or operations upon the abdominal wall and abnormal length of the mesentery.

The chief **exciting causes** are sudden strains while the body is in a position in which the abdominal orifices are not protected; therefore the condition is more frequent in men than in women.

The symptoms of hernia are too well known to need description.

CLASSIFICATION.—Hernia may be classified into two groups:—1. According to the anatomical situation of the hernia; and 2. according to the character of the hernia itself. The latter is the more important from the point of view of treatment, and is further subdivided into the reducible and the irreducible herniæ.

Reducible hernia.—In this form the contents can be returned into the abdominal cavity by manipulation; with the exception of those having no proper peritoneal sac all herniæ are usually reducible in the first instance.

Irreducible hernia.—Irreducibility is an extremely important factor in treatment and may depend on various conditions which must be carefully separated from each other. We may distinguish the following classes: (*a*)

Simple irreducible hernia; (*b*) Obstructed hernia; (*c*) Inflamed hernia; and (*d*) Strangulated hernia.

(a) Simple irreducible hernia.—By far the most common cause of irreducibility is adhesion of the contents of the hernia to the wall of the sac, and this may occur at the neck or in the body of the sac or in both combined; the adhesions are generally omental, but in long-standing cases the bowel may be adherent either to the omentum (which may also be adherent to the sac wall) or to the latter alone. Sometimes all three may be inextricably matted together, especially in umbilical hernia. The adhesions are due to attacks of localised peritonitis, and are usually set up by the long-continued pressure of a badly-fitting truss. Another cause of irreducibility is a disproportion in size between the neck of the sac and the contents; thus the herniated omentum often increases in size from inflammatory exudation or by the deposit of fat and cannot pass back into the abdomen.

There may be no special symptoms, but sometimes there is a dragging pain from the pull on the intestine often increased after food.

(b) Inflamed hernia.—This variety is always described but is not very definite in nature. It is due to a simple inflammation which generally follows either a direct injury or pressure from a badly-fitting truss. The inflammation takes the form of a localised exudative peritonitis which transforms a previously reducible hernia into an irreducible one.

The symptoms are often too slight to attract special attention; sometimes all that is noticed is that a truss cannot be worn on account of pain. When the inflammation is more severe the condition may be mistaken for true strangulation, but the symptoms are quite different on careful inspection; there is pyrexia, localised pain and a definite impulse on coughing.

(c) Obstructed hernia.—This form borders closely on the strangulated one in which it often ends. By the term is meant a hernia in which the passage of fæces is interfered with or entirely interrupted, without any true strangulation. The patient is very constipated and may suffer from colicky pains, but there is still an impulse on coughing and none of the special symptoms of true strangulation into which, however, the condition frequently passes if unrelieved as the increasing distension of the bowel interferes with the circulation in the loop.

Another name sometimes given to these herniæ by some authors is *incarcerated hernia:* the term is a bad one and there is no practical advantage in its use.

(d) Strangulated hernia.—Here not only is the passage of the contents interfered with, but the circulation in the mesentery and bowel is also affected, and the condition is correspondingly much more grave. The mechanism is practically identical with that of acute intestinal obstruction from internal strangulation (see p. 316). The constriction is usually at the neck of the sac and very often is caused by that structure itself; the neck of the sac becomes thickened, especially after the prolonged use of a truss, and forms an unyielding ring which prevents the return of the bowel and impedes

the circulation of blood in it. In other cases the constriction may be at the abdominal orifice through which the hernia passes, *e.g.* in femoral hernia, where Gimbernat's ligament plays an important part. More rarely still the constriction is within the sac itself; *i.e.* the bowel becomes strangulated either through a hole in the omentum or under adhesions between the latter and the sac wall. It is most important to remember that in large strangulated omental herniæ the contents of the sac must not be put back *en masse* but that the omentum should be opened out first so as to make sure that no knuckle of bowel is caught in it.

The changes in the bowel.—The strangulated loop becomes congested and darker in colour until it gets purple or even black; its walls are distended and œdematous and lose their suppleness. The peritoneal coat, which at first retains its polish, later on loses it, shows sub-serous hæmorrhages and in the later stages becomes grey and gangrenous in spots and finally all over. All strangulated herniæ which have lasted long enough become gangrenous, and it is most important to recognise impending gangrene from the local appearances. A mere dark colour does not imply gangrene so long as the bowel is firm and elastic and the peritoneal coat is glistening but, directly the latter loses its polish and the bowel becomes soft, the condition is very grave. When actual gangrene is present, the gut becomes greyish and there are often soft greyish spots on the convexity of the loop when the peritoneum has lost its lustre. There is a definite sulcus at the seat of constriction and here the lesions are most profound and gangrene usually occurs first. This must therefore always be examined before the intestine is returned into the abdomen.

The changes are most marked in the proximal portion of the constricted loop and are generally more intense along the convex than along the mesenteric border. In the former situation the bowel wall is thinned instead of being thickened as is the rest of the loop and may be gangrenous. The mucous membrane is generally affected first and most severely and stricture of the bowel occasionally follows some time after an operation for strangulated hernia, presumably as the result of sloughing of the mucous membrane at the time of strangulation.

The mesenteric vessels are affected and extensive thrombosis of the veins may be present. This is a point of the very greatest importance, because gangrene will certainly occur if the thrombosis be extensive even though the bowel be not gangrenous at the time of the operation; moreover the process is apt to extend and so to interfere with the circulation in the other coils. If therefore a loop be returned with its mesenteric veins thrombosed it will become gangrenous later on in spite of the relief of the strangulation; and moreover, unless the whole of the thrombosed area be removed at the original operation, the thrombosis may spread to neighbouring veins and gangrene may still occur in the bowel beyond the seat of resection.

The changes in the omentum are similar but not so marked as in the bowel and it is rare to find the omentum gangrenous; it usually becomes

matted together, tough and œdematous. The presence of omentum in the sac along with intestine is a favourable condition as it minimises the chances of gangrene of the bowel itself, because the constriction of the latter is rarely so tight as when it alone occupies the sac. When the omentum alone is strangulated the symptoms are not usually so severe as when bowel is present in the sac and they may even subside spontaneously.

There is always some fluid in the hernial sac and in a strangulated hernia it is abundant, being serous in the early stages, then blood-stained and finally fœtid; this is very marked in commencing gangrene. Before the last stage is reached the fluid usually contains organisms, at first the bacillus coli communis; when gangrene is impending, streptococci and other pyogenic organisms appear. This is an important additional reason in favour of operation in preference to taxis; it is not well to return fluid containing bacteria into the abdomen although possibly in the early stages a few colon bacilli are of comparatively little consequence.

Symptoms.—These are very characteristic, especially when the hernia contains bowel. The tumour is irreducible, becomes considerably larger than it was before, loses its impulse on coughing, is dull on percussion, tense, and tender to the touch. The general symptoms are identical with those of internal strangulation (see p. 314). When the hernia contains only omentum the symptoms are not so marked and the case may be mistaken for an inflamed rather than a strangulated hernia. The loss of the impulse on coughing in strangulation however is an important point, while in inflamed cases vomiting, though often present, is seldom fæcal and absolute constipation is not necessarily present although the bowels are usually sluggish.

Richter's hernia.—A comparatively rare form of strangulated hernia called Littré's or Richter's hernia requires mention; in it a portion only of the circumference of the bowel is nipped instead of a complete loop. This probably occurs more often in femoral than in inguinal hernia and is by no means easy to diagnose as there may be no tumour present, unless omentum be also in the sac, and there may be no constipation since the lumen of the bowel is not actually interfered with; vomiting may not be marked and flatus often passes freely. The constitutional symptoms however are well marked; the pulse is small and rapid, the breathing is hurried and there is the same anxious aspect as in complete strangulation. The portion of intestine nipped is usually badly damaged and gangrene often commences quite early.

TREATMENT.—The treatment of hernia depends on such varying conditions as the age of the patient, the particular form of the hernia, its reducibility or irreducibility, the presence or absence of strangulation, and the general fitness of the patient for operative interference; all these points will be dealt with in connection with the individual forms of hernia (see Chap. XXIII.). We shall here indicate the general principles that must be taken into consideration in deciding on the best form of treatment.

As the question must be largely influenced by the reducibility or irreducibility of the hernia, we may divide the subject into the treatment suitable for reducible and irreducible hernia respectively.

TREATMENT OF REDUCIBLE HERNIA.

Two chief methods are at the disposal of the surgeon, namely (1), reduction of the hernia by manipulation and its retention by a suitable truss; or (2), the so-called "radical cure," by which the contents of the sac are reduced, the latter obliterated and some amount of closure of the hernial orifice effected.

The question of operative versus non-operative methods is influenced by many considerations; in the first place by the form of the hernia and the probability of permanent cure by operation; in the second, by the age of the patient. Another point of importance is the patient's occupation and whether he is able to obtain medical assistance should strangulation occur. The subject of a hernia is not admitted in many of the services and for this reason operation may be decided upon. The question must also depend on the health of the patient and the size of the hernia.

(a) In infants.—Hernia in infancy is usually umbilical or inguinal and several points have to be borne in mind in connection with it; an infant does not stand an operation well, he is frequently crying and this throws undue strain on the stitches and may endanger union, while the abdomen is difficult to keep clean and sepsis may occur at or after the operation. It must also be borne in mind that herniæ in young infants, if properly attended to, are often cured without operation. Therefore, unless the hernia be strangulated,—which is very rarely the case,—we do not advise operation at this early period of life. The parents must be impressed with the fact that, if they will only take the necessary care, the hernia may be cured without operation.

Palliative treatment.—Proper support must be afforded by suitable apparatus and special care must be taken never to allow the hernia to descend into the sac. The actual management of herniæ in different situations is described separately (see Chap. XXIII.); we need not say more here than that the truss must not irritate the peculiarly sensitive skin of the infant, that it must be so designed as to press the sides of the opening together, that it must be worn day and night and that in changing it the nurse must take the greatest care to make pressure over the opening and prevent the descent of the hernia while a fresh truss is being applied; the child should have a number of trusses, so that a clean one is always at hand. Unless these precautions be taken, the hernia will descend fairly often while the truss is being changed and the chances of cure by truss treatment will be extremely small.

A cure is obtained usually within two years from the commencement of the treatment, often within the first year. If after careful treatment for

eighteen months or two years the hernia does not descend, the truss may be left off, and a watch kept to see whether the cure is permanent.

(b) In children of two years and upwards.—As a rule the herniæ met with in young children have lasted from infancy, for it is comparatively rare for a hernia to be developed between the ages of two and ten. When the hernia has persisted from infancy the chances of a cure by truss pressure become increasingly small, and after the age of six most remote.

Radical cure.—In these cases, therefore, we have to face the question of operative interference, and the main point is *the best age at which to practise a radical cure.* From the point of view of permanent cure, there is no question that the earlier the operation is done the better; the longer the hernia lasts, the greater is the dilatation of the abdominal opening and the more difficult its closure. Moreover, after two years of age the child is running about and is more exposed to injury, while the chances of strangulation are proportionately increased. A radical cure done in childhood is usually very satisfactory; the abdominal walls develop just as if no hernia had ever existed.

The most important consideration however is the self-control of the child. After an operation a very young child is generally frightened, and whenever it is moved, and more especially when it sees the doctor, it begins to cry and throws strain on the seat of the operation, which may thus have its objects defeated. Moreover, the risk of sepsis is still present if the child be not old enough to be cleanly, and we therefore advise waiting until the child is not likely to be frightened and until he is thoroughly capable of keeping himself clean. Given those conditions, the sooner the operation is performed the better. While waiting for the operation a truss should be worn.

In children over six years of age we are strongly of opinion that a radical cure should be performed without any attempt to cure the hernia by the application of a truss.—A child at this age is quite amenable to control, repair takes place with the greatest readiness, and the results are most successful. At this age also the child is about to go to school and, if he has to wear a truss, he is likely to be at a great disadvantage; he cannot join in athletic sports, and he is constantly exposed to the ridicule of his schoolfellows, while he is not of an age to manage the truss himself, and the hernia is likely to come down beneath it and thus to expose him to serious danger.

(c) In adults.—Here the main question is whether radical cure should be performed, or whether the patient should wear a truss.

The question of "radical cure" versus truss treatment.—The chances of cure of a hernia by truss treatment in a young adult are slight while the radical cure, of inguinal hernia at any rate, is extremely successful. The hernia is usually of moderate size, the muscular walls of the canal through which it comes are strong and the muscles readily develop after operation so as to support the opening in the normal manner. Numerous drawbacks affect a young adult with hernia; he is debarred from the various services, he is under many disadvantages in going abroad and is

subject to constant trouble with his truss which incapacitates him in many ways. He is often exposed to violent strains which expose him to the risk of the hernia slipping down behind the truss, he nearly always wishes to pursue occupations or amusements demanding full vigour, and he may be likely to be out of reach of medical aid for considerable periods.

We therefore would strongly advise that, unless there be some definite contra-indication, a hernia in a young adult should be operated on by one of the methods which will be described later (see Chap. XXIII.). The contra-indications in these subjects are comparatively few. The principal one is some illness which makes the patient an invalid or which absolutely forbids operation.

On the other hand, however, feeble, old people with flabby abdominal walls who are accustomed to wear a truss and do not object to do so, and whose occupation is sedentary, should not be urged to undergo the operation if the hernia be reducible and a truss keeps it up. In elderly alcoholic and bronchitic subjects also operation is inadvisable.

Radical cure.—The methods of performing the radical cure will be dealt with in connection with the individual forms of hernia (see Chap. XXIII.). *The question is often raised as to whether the hernia is really cured by operation or not.* It is very difficult to give precise figures on this point. Patients who have been operated on are lost sight of, and besides, if the operation has been unsuccessful, the patient seldom returns to the surgeon who performed it, but seeks the advice of another. On the other hand the statistics of the officials of Truss and Surgical Aid Societies, which put the percentage of recurrences higher than that of any individual surgeon, are not reliable. Patients apply to these societies from all quarters and there is no possibility of ascertaining what operation has been done—a very vital point, as much depends on the operation performed and the subsequent healing of the wound. Further, many patients who are under the impression that they have had a radical cure done have really been operated upon for strangulation and no radical cure has been attempted.

When however a considerable number of cases can be traced, as can generally be done in private practice, it is found that the vast majority of operations done in childhood and youth are completely successful if done on proper lines (see Chap. XXIII.), and even in elderly subjects the success is greater than might be expected. *It must not be forgotten that in elderly people the operation is done not so much to effect a true radical cure as to enable the patient to wear a truss comfortably*; the term "radical cure" is not meant to apply solely to cases where the operation is likely to be absolutely curative, but to any operation having for its object the return of a hernia and its retention inside the abdomen by means that were not previously available.

Perhaps the most unsatisfactory cases are those in which strangulated hernia has been operated upon without any attempt to perform a radical cure. Here the abdominal opening and the neck of the sac have been enlarged and

when the patient gets about there is frequently a much larger hernia than before, and this comes through a canal which is now cicatricial instead of muscular, so that there may be great difficulty in getting a truss to keep it up. Operations involving much cicatricial tissue seldom or never bring about a real radical cure, and, as a satisfactory truss can seldom be found for these cases, it often becomes necessary to perform an operation on the lines of the ordinary radical cure, the object of the operation being rather to enable the patient to wear a truss than to enable him to dispense with one altogether.

Palliative treatment.—This consists essentially in the employment of *trusses*; particulars of these will be given in connection with the individual herniæ (see Chap. XXIII.), but we may here indicate the general principles underlying their use. The typical truss consists of a spring of tempered steel embracing a certain proportion of the circumference of the pelvis to which is attached a pad so designed as to occlude the hernial orifice.

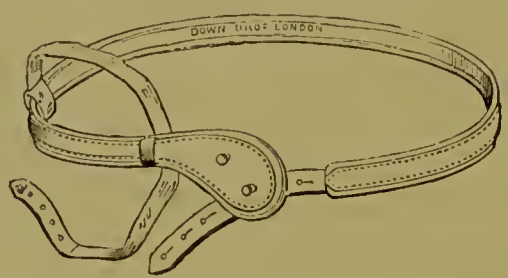


Fig. 106.—Single Truss for Inguinal Hernia.

In the ordinary truss (see Fig. 106) the spring encircles the trunk on the affected side; one end is attached to the pad while the other lies in close contact with the skin over the sacral region and is continued by a strap passing round the other half of the pelvis and attached by a stud to the pad. The stoutest part of the spring is where it is attached to the pad. Most trusses are also supplied with a perineal band which is fastened behind to the spring and in front to a stud on the pad. The pad varies in shape and in the material of which it is constructed, the shape depending essentially on the kind of hernia. It is usually a metal plate of suitable size and shape firmly padded with horsehair and covered with some soft material like chamois leather, which however has the disadvantage that it may after a time become hard and offensive from absorption of decomposing sweat. Pads are also covered with indiarubber and may contain glycerine or air, but the pressure in them is liable to be variable and there is a danger of puncturing the pad and rendering it useless just when it is most difficult to replace it. Every truss should be made specially for the patient who is to wear it and great care should be taken to shape the pad so as to retain the hernia. To go into a shop and buy a truss because the spring fits the pelvis nicely is not likely to give a good result. If a double truss be required it may consist either of a single spring or, better, of two separate springs encircling the corresponding halves of the pelvis and fastened together behind.

A comfortable form of truss is shown in Fig. 107 in which the pad is attached to the spring by means of a ball-and-socket joint; these are in some ways preferable to the preceding form although they have the disadvantage that they are not suitable for bilateral hernia, and that, if displaced, there is not the same tendency to slip back into position as there is in the ordinary truss; the pressure they exert is also greater and, if the hernia comes down beneath them, more damage is likely to ensue.

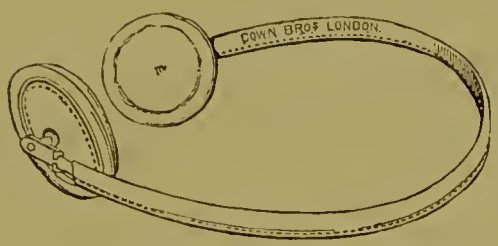


Fig. 107.—Truss for Inguinal Hernia. The spring passes round the sound side of the pelvis.

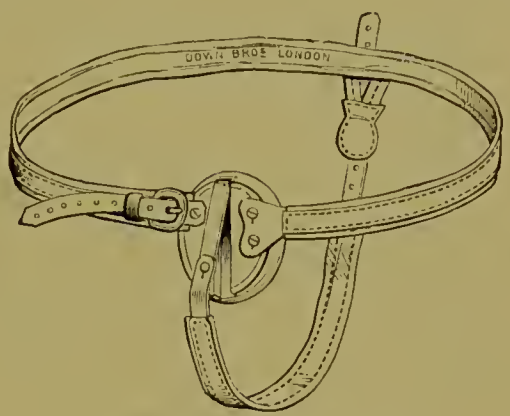


Fig. 108.—Moc-main Lever Truss.

Another form is the Moc-Main lever truss (see Fig. 108) which consists essentially of a pelvic and a perineal band, the pressure being made on a specially shaped pad by means of a spring. This is a very comfortable truss but the pressure is comparatively slight and the pad is rather easily displaced. It is very useful in small, easily reducible herniæ in subjects who are exposed to no exertion.

General points concerning trusses.—A properly fitting truss should fulfil the following conditions: It should not inconvenience the wearer when at rest, while it should be powerful enough to keep up the hernia during any movement of the body; this can hardly ever be effected without some spring apparatus. The surgeon should never leave the choice of the kind of truss to the instrument-maker. The size and shape of the pad should be specified together with some idea of the amount of force required to keep the hernia in position. The latter point is ascertained by reducing the hernia, keeping the thumb or forefinger over the orifice and making the patient cough or strain. The size of the ring is also a necessary point and should always accompany the instructions to the instrument-maker.

In applying the truss the patient should first lie down and reduce the hernia, which he usually does readily after a little practice. While he is in the horizontal position he should pass the spring of the truss around the body, the pad lying well above the hernial aperture. He now makes sure that the hernia is entirely reduced and then slips the pad into position; the truss is then fastened and the perineal band, if used, applied. In order to test the efficiency of the truss the patient should be examined sitting and walking and should be made to cough and to lift weights: under all conditions a suitable truss will keep back the hernia.

In our opinion the truss should be worn continuously night and day. Many authors hold that, unless there be some distinct reason, such as chronic bronchitis, it is needless to wear the truss at night, but there is no doubt that sudden movements in bed or during sleep, a fit of sneezing or coughing, may force down the hernia and may lead to serious consequences; quite a number of strangulated herniæ occur during the night. As however the strain on the truss is only slight during the night a much lighter spring may be used. An indiarubber-covered truss is also required for use in the bath.

The skin beneath the pad is apt to become excoriated chiefly from friction and the accumulation of moisture; the sweat decomposes and soaks into the pad which soon becomes hard and foul and is a further source of irritation. The parts should always be well cleaned night and morning and dusted with equal parts of boracic acid, oxide of zinc and starch or powdered talc, while between the truss and the skin a piece of boracic lint should be inserted to absorb the moisture; it is also well to have linen covers to the pad which can be changed frequently so as to keep it clean.

If the truss causes pain it either fits badly—in which case an alteration in the spring or a readjustment of the pad will cause the pain to disappear—or else there is adherent omentum in the sac which gets pressed on and gives rise to pain; in other words, the hernia is not completely reducible.

Careless patients may adjust the truss before the hernia is quite reduced and there is then pain and inflammation and a previously reducible hernia may be soon transformed into an inflamed and irreducible one. A similar accident occurs when the truss does not keep up the hernia completely; one of the commonest causes of irreducibility is imperfect truss support.

Much rarer complications caused by wearing a truss are adenitis and the occurrence of varicose veins. These are generally due to the use of too powerful a spring and are remedied by altering it or the shape of the pad. In inguinal hernia one of the best shaped pads is Wood's horseshoe pad (see Fig. 109) in which there is a deep notch allowing the cord to escape through the external ring without being pressed upon.

TREATMENT OF IRREDUCIBLE HERNIA.

A SIMPLE IRREDUCIBLE HERNIA is generally due to adhesions between the contents of the sac and its wall; it may also be due to increase in size of the contents after they have been in the sac for some time. Irreducibility is practically always associated with the presence in the sac of omentum which readily becomes adherent from truss pressure after imperfect reduction, or which increases in size either as the result of the deposit of fat or of inflammatory thickening and can no longer be returned into the abdomen. Rarer causes are the presence in the sac of an organ like the cæcum.

In all cases of irreducible hernia it is advisable to perform a radical cure unless there be some definite contra-indication. No form of truss will keep up the hernia, and therefore the patient is liable at any time to the occurrence of strangulation. If a truss be applied to prevent the descent of fresh portions of bowel or omentum it increases the irritation of the already irreducible omentum and may lead to an inflamed hernia; in any case it makes the condition worse. The only kind of truss that is ever permissible is a hollow or bag truss (see Fig. 110) and this is rarely of much use.

The object of operation here may be either a true radical cure or merely to enable the patient to wear a truss, and therefore the operation should be more strongly pressed than in cases of reducible hernia, while the question of the patient's age is by no means so important. The size of the hernia

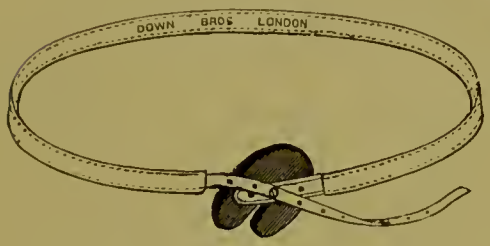


Fig. 109. Wood's Horseshoe Pad.

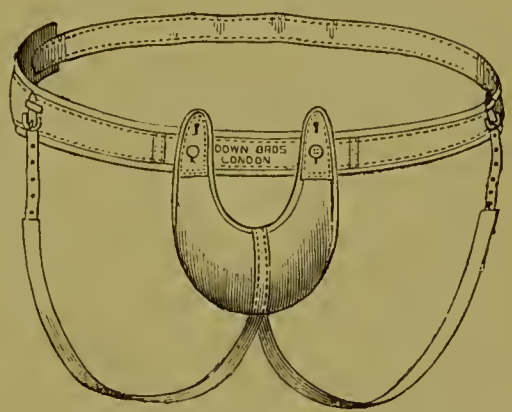


Fig. 110.—Bag Truss for Irreducible Inguinal Hernia.

must influence the question to some extent, and a very old subject with a very large scrotal hernia or with grave constitutional disease may be deemed safer if he wears a suitable bag truss than if he underwent an operation for radical cure; in the great majority of cases however operation is the proper treatment.

OBSTRUCTED AND INFLAMED HERNIÆ. — These cases, especially the former, are very important, because, if the condition persists, it is very apt to end in strangulation.

Radical cure.—Unless there be a strong reason to the contrary, we are strongly of opinion that it is well to make the condition of the hernia an excuse for insisting on a radical cure. Obstructed and inflamed herniæ doubtless often recover under careful medicinal treatment (see p. 428), but they are usually also irreducible and they are therefore really cases in which a truss is inefficient and the attack of obstruction or inflammation is very likely to give rise to increased adhesions, while it is impossible to be sure that strangulation may not at any time supervene under unfavourable circumstances. On the other hand, if the attack be overcome after prolonged treatment, the patient is usually unwilling to give up further time to a radical cure and there is no objection to operating on an obstructed

or even an inflamed hernia, while the patient will probably submit to it at once if the state of matters be thoroughly explained to him.

Palliative treatment.—Should the patient refuse operation or should one be considered inadvisable, he should be kept rigidly in bed on his back with the knees flexed over a pillow so as to relax the abdominal muscles as much as possible. Cold should be applied to the hernia whether it be inflamed or simply obstructed and this is most effectually done by means of Leiter's tubes. The diet, which must be regulated so as to leave the least possible undigested residue, should be largely fluid and should be given in small quantities at frequent intervals. The lower bowel should be cleared out by repeated enemata, each of which may with advantage contain from one to four drachms of turpentine. Aperients should be avoided, but belladonna and strychnine may be given by the mouth so as to increase peristalsis so long as their effects are carefully watched. From time to time very gentle and careful taxis should be applied, unless there be marked inflammation, and in the intervals the hernia should be supported and if possible compressed by a suitable elastic lace-up truss. In inguinal and femoral cases the return of the hernia is expedited by raising the foot of the bed on blocks. Opium should be avoided unless there be marked pain. Should signs of strangulation appear immediate operation must be undertaken.

After the condition of obstruction or inflammation has passed off, the patient should be again urged to submit to a radical cure unless there be some serious contra-indication, because the condition is very liable to recur and may next time end in strangulation.

STRANGULATED HERNIA.—In strangulated hernia it is absolutely essential that the bowel should be returned to the abdominal cavity with the least possible delay quite irrespective of the age or constitutional condition of the patient, and the surgeon has only two alternatives before him, namely, to attempt to effect this either by taxis or by operative measures. Unless the strangulation be relieved the patient will almost certainly die ; the number of cases which recover after the spontaneous formation of an artificial anus is so small as not to be worth taking into account. Time should not be wasted upon such measures as warm baths, the administration of opium, the application of ice, etc.; if any of these be had recourse to, they should only be employed while preparations are being made for operation.

Taxis.—In former days the principal method of treatment was by taxis and it was only after failure of this that operation was resorted to. Nowadays, however, in view of the great safety and the great value of operative interference in non-strangulated hernia, most surgeons are coming round to the opinion that the first question to be considered is that of operation as against taxis. The great *objections to taxis* are that considerable force has often to be employed and that, with a tight strangulation, the bowel may be so badly damaged as to seriously complicate subsequent operation ; actual rupture of the bowel at the seat of constriction after taxis has occurred frequently. For properly applied taxis an anæsthetic is necessary whereby the chief risk of

operating in these cases is already incurred; the experience of radical cure amply proves that the risk of operation *per se* is practically *nil*.

Various accidents may also happen in taxis quite apart from bruising or rupture of the bowel; there may be a diverticulum from the sac under the abdominal parietes and the external hernia may be reduced into this with the strangulation unrelieved, or the sac may burst below the neck and the bowel may be reduced, still strangulated, into the sub-peritoneal tissues. Again the hernia and the sac together may be reduced *en masse* inside the abdomen, or the strangulation may have occurred beneath some band or through some hole in the omentum in the interior of the sac and reduction of the hernia as a whole may be practised without affecting this. A further consideration is that after reduction of the strangulated hernia by taxis, nothing has been done to effect a radical cure and the condition may recur at any time.

Considering therefore the great safety of operative interference as compared with the risks of taxis, we unhesitatingly condemn the employment of taxis at all unless in very rare cases. When once the patient is under the anæsthetic,—and that is necessary for efficient taxis,—there is no reason whatever why operation should not at once be proceeded with without subjecting the patient to the considerable risks of taxis. Taxis should certainly never be employed in femoral herniæ, nor in any hernia that has been strangulated for more than 24 hours, and if done in any case it should only be practised by the surgeon who is responsible for the entire treatment of the case, and he should be ready to proceed to operation at once if taxis fails or if any of the accidents mentioned above occur. It should not last more than ten minutes in any case and not so long unless it be evident that an impression is being made upon the tumour.

The only cases in which we should employ taxis in preference to operation are umbilical herniæ in which the strangulation has lasted only a short time and where the patient is in a bad condition for the prolonged operation necessary to effectually reduce the hernia, or in very large scrotal herniæ in old people where there is a doubt as to the possibility of returning the whole contents into the abdominal cavity. Fortunately, strangulation is extremely uncommon in these last cases.

Although we strongly condemn taxis as the ordinary procedure in strangulated hernia we shall briefly indicate the important points in performing it. It should always be practised under an anæsthetic unless there is some strong reason to the contrary. Before administering the anæsthetic, it is well, if time allows, to wash out the stomach so as to diminish the risk of vomited material passing into the air-passages; it is well also to empty the bladder and the lower bowel. Taxis should be very carefully and gently employed, and should only be attempted on the operating table and not on the bed. The pelvis should be well raised, full muscular relaxation should be secured by suitable position, and the hernial orifice should be made the highest point of the body. With the thumb and

forefinger of the left hand the surgeon grasps the neck of the sac and pulls it down in the direction of the canal, and thus prevents the hernia, when pressed up by the other hand, from overlapping the edge of the orifice, and so guides it in its proper course. The entire hernia is grasped with the other hand and gentle and equable pressure is exerted on the tumour by the whole hand; the tips of the fingers should not be pushed into the sac. The object is to gradually squeeze out the contents of the incarcerated loop so that the emptied bowel may pass back through the ring: unless this be done, it is mechanically impossible for it to do so. The experienced surgeon will soon be able to tell whether or not the taxis is likely to succeed. The chief indication of success is the gradual diminution in the size of the tumour. As the last of the contents are reduced the bubbling of gas is often felt; when this happens, and not before, the compression of the sac is changed to a steady upward pressure so as to push the loop up through the hernial orifice.

Operation.—The exact steps of the various operations will be detailed in connection with each particular form of hernia (see Chap. XXIII.). In the first place the hernial sac and its coverings are exposed, and the condition of affairs is made out. The coverings are then divided; it is not always possible to define these *seriatim* as they have become œdematous. They must be divided at their point of attachment to the denser fibrous structures, *i.e.* the rings. The surgeon then gradually separates the tissues until the sac wall is evident, when the coverings are slit up right to its neck; then, by gently pulling down the sac, it can be made out whether the constriction is in the neck or whether it is due to the rigid abdominal ring. In the former case it is often possible to relieve the constriction by nicking the tissues around the neck; in the latter the opening should be enlarged in certain definite directions upon either the finger-nail or a director insinuated between the neck of the sac and the abdominal parietes. If it be necessary to enlarge the opening in the abdominal parietes—*i.e.* to incise the ring—this is better done before the sac is opened, as there is then much less risk of injuring the bowel.

The next step is to open the sac below, taking care, however, to ascertain first that the bowel is not adherent to its wall. As a rule the sac of a strangulated hernia contains fluid which, except in old irreducible cases, distends it and removes its wall widely from the intestine. A small portion of the sac is pinched up and nicked, a director is introduced and the sac is laid freely open. The contents are inspected and an estimate made as to their probable vitality. The opening in the sac is now carried up through the neck upon a director inserted beneath it, taking great care not to cut the bowel in so doing. The loop is then gently pulled down so as to examine the seat of constriction; if this at once expands and does not show any loss of polish, the bowel may be safely reduced.

The condition of the circulation in the bowel and its mesentery should

also be examined so as to ascertain if the vessels be thrombosed, as this might interfere with the subsequent vitality of the bowel. Before returning the loop it is well also to flush it freely with salt solution, especially if there has been much fluid in the sac. The omentum, if adherent and much thickened, is pulled down until a normal portion is reached and is then transfixed with a silk ligature threaded on an aneurysm needle, tied, divided and the stump returned while the remaining portion is dissected away. It is inadvisable as a rule to return omentum from a strangulated hernia into the abdomen as it is apt to be a source of septic infection or at any rate to lead to adhesions. Care must be taken in removing it not to go nearer than an inch to the transverse colon; otherwise a kink may be caused.

When there is no doubt as to the propriety of returning the bowel the operation should be completed by a radical cure (see Chap. XXIII.). The time occupied by this is comparatively short and the immense advantage in performing it lies in the fact that not only is recurrence prevented, but the radical cure is done under much more favourable circumstances than if it were undertaken after the wound has healed, when a large amount of cicatricial tissue is present.

In doing the radical cure, the sac should be excised as it is generally in a bad condition and if twisted and left is very likely to be a source of infection. This should always be done even when a radical cure is not undertaken. Before removing it, care must be taken to ascertain that there are no structures adherent to its neck. The sac is sometimes abnormal and possesses constrictions or diverticula in more than one part of its course, and it is important that its entire extent should be exposed; in an inguinal hernia for example the external oblique should be slit up to allow of this.

Difficulties in the operation for strangulated hernia.—The two first difficulties are adhesion of the contents to the sac, and the recognition of the sac wall. Thus, when there is much omentum adherent to the sac wall and very little fluid, the layers of the omentum may be actually separated under the impression that the coverings of the sac are being removed. If there be doubt, the best plan is to get as near the neck of the sac as possible, and usually if the whole sac be exposed before an attempt is made to open it some point can be made out where fluid is present and where therefore it will be safe to incise; the rest of the sac may then be readily separated before any attempt is made to reduce the hernia.

The intestine is only adherent to the sac when there have been recurrent attacks of inflammation except in the case of the large intestine, *e.g.* a cæcum without a proper meso-cæcum. The connection between the bowel and the sac wall may be so intimate that it is impossible to free them, and it may then be necessary to return the bowel into the abdomen with a portion of the sac wall attached to it. In separating these adhesions the bowel is easily ruptured as it is very soft.

Abnormal contents of the sac.—The *bladder* is not uncommonly found in connection with the sac in both inguinal and femoral herniæ and may

either bulge into it and form part of its contents or more commonly may be applied to the inner side of its neck, being pulled down along with the peritoneum; it has happened that the fleshy mass in this situation has not been recognised as the bladder and has been torn when separating the neck of the sac, or, what is apparently still more common, a portion has been included in the ligature applied to the neck of the sac. We know of two cases of femoral hernia where this occurred; it is an additional reason for seeing exactly what one is doing before ligaturing the neck of the sac.

Among other abnormal structures found in a hernial sac are the *ovary* and *Fallopian tube* or the *appendix*. An appendix in a hernial sac, whether strangulated or not, is usually elongated and thickened and will readily become the seat of appendicitis. Hence, it is always well to remove the process during the operation (see p. 390), but when the patient cannot stand any prolongation of the operation it may be returned unless it be seriously damaged. The ovary or Fallopian tubes should be returned unless they are considerably damaged, in which case the comfort of the patient will be best secured by removing the affected structure through the operation wound.

Treatment when the vitality of the contents is defective.—Much more serious are the cases where the contents of the sac have begun to lose their vitality. If on opening the sac the surgeon finds that it contains blood-stained fluid and that the bowel is a deep purplish brown, the peritoneal surface dull in places with greyish or greenish-brown patches, the condition is one of commencing gangrene of the intestine and, although the protruded loop may be sound, the changes at the seat of constriction are so far advanced as to render gangrene at that point inevitable, or the vessels in the mesentery of the strangulated loop are thrombosed and therefore gangrene, if not actually present, will soon occur. The prognosis in a gangrenous hernia is extremely grave.

Intermediate between the cases in which the loop is evidently quite sound and those in which it is obviously gangrenous are quite a number in which its condition is doubtful. The surgeon is not sure whether it will recover or whether it will become gangrenous. The chief guide is the condition of the circulation in the loop after dividing the stricture; if this be readily restored, the loop will probably recover; otherwise not. The presence of small greyish patches or hæmorrhages beneath the peritoneal coat in a bowel not actually gangrenous points to the probability of perforation; the danger of returning the bowel is therefore great.

We shall consider the question of treatment under two headings, viz. 1. When the condition of the bowel is suspicious, and 2. When gangrene has actually occurred.

1. When the condition of the bowel is suspicious. — One plan is to return the bowel just inside the hernial aperture, after relieving the constriction and washing the loop with salt solution, so that the doubtful portion lies over the ring and then to leave the wound open with large

drainage tubes and a few strips of gauze passing through the wound up to the doubtful bowel. The advantage of this is that no second operation is required should recovery of the bowel take place while, should perforation occur, there is every probability that the affected portion will be shut off by adhesions quite early and that the intestinal contents will escape along the drains already arranged (see Fig. 111, *a*).

When there are only one or two suspicious spots on the bowel and it is decided to return the latter, it is well to invert the suspicious area by Lembert's sutures so that, should they become gangrenous, no perforation will take place into the abdominal cavity.

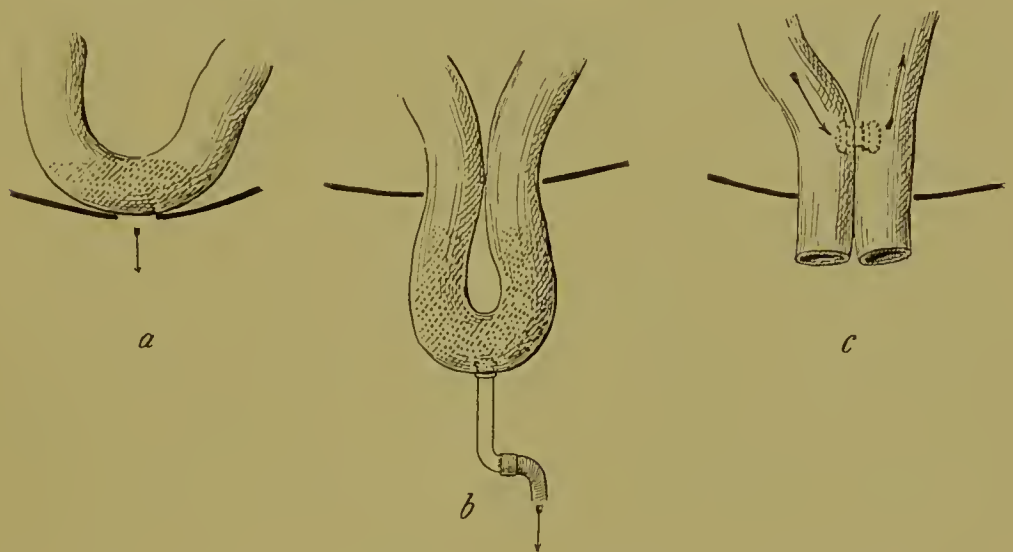


FIG. 111. — DIAGRAM ILLUSTRATING THE METHODS OF TREATING A LOOP OF STRANGULATED INTESTINE WHEN GANGRENE IS IMPENDING OR IS ACTUALLY PRESENT. In *a* the suspected loop (shown dotted in the figure) is returned just within the ring through which free drainage, in the direction of the arrow, is provided. In *b* a Paul's tube is inserted and a fæcal fistula established, while in *c* the gangrenous loop has been cut away, leaving an artificial anus. In this diagram is also shown a lateral anastomosis by Murphy's button between the afferent and efferent limbs of the loop.

Another alternative is to divide the neck of the sac, cleanse the sac and the suspected loop, and pull down the latter so as to relieve all constriction and then to fix it in the wound either by strips of gauze or by stitches. The wound should be left open and covered with protective and the usual dressings applied outside until it is seen what is going to happen. If gangrene and perforation occur, a moist boracic dressing should be applied until the sloughs have entirely separated; on the other hand, if the bowel is going to recover, this will be evident in a few days' time and the patient should then be put under an anæsthetic in about a week, the newly-formed adhesions separated with the finger, the bowel returned into the abdomen and the wound closed.

2. When there is actual gangrene of the bowel.—The case may be seen before or after perforation has occurred. In the former event two procedures are available, namely, 1. Excision of the affected loop of the bowel followed by either (*a*) an artificial anus to be subsequently closed or (*b*) an

immediate end-to-end anastomosis; or 2. Division of the constriction followed by fixation of the affected loop well down in the wound, so that adhesions shall form round the abdominal opening while the perforation takes place lower down. This gives an artificial anus which must be subsequently closed if the patient survives.

Immediate resection and anastomosis.—The ideal plan and the one which should always be first considered is resection of the affected loop followed by immediate end-to-end union, and of late years, owing to more rapid methods and greater care, this is getting to be regarded as the best procedure in all suitable cases; the steps of the operation have been fully described (see p. 307). Murphy's button (see p. 310) is the speediest and perhaps the best method of uniting the bowel under these circumstances though, if the patient's condition be good, we should prefer a Robson's bobbin (see p. 309); the condition of the patient however is often such that every moment is of importance and there Murphy's button is indicated. In practising excision, the bowel must be cut through on each side at some considerable distance from the seat of constriction so as to make quite certain that the line of union is perfectly healthy and that the circulation is unimpaired as otherwise sloughing of the line of union might occur. A wedge should be taken out of the mesentery (see Fig. 92) including all damaged vessels; the amount of bowel resected will be to some extent governed by the size of the wedge of mesentery it is necessary to remove. The time taken in performing end-to-end anastomosis by Murphy's button is not much more than that required to pull down the gangrenous bowel and fix it in the wound, while, if successful, it saves the patient a second difficult operation for the closure of the artificial anus.

Artificial anus.—If however the patient's condition be very bad either from general poisoning, old age or shock, an artificial anus will probably give him a better chance, which will be increased if a Paul's tube be inserted in the loop (see Fig. 111, *b*) and an attempt be made to empty the bowel above, as is done for acute intestinal obstruction (see p. 325). The patient is thus relieved from the poisoning by the putrid intestinal contents which will not otherwise escape freely until the bowel sloughs; that does not occur for some two or three days.

Still more serious is it to find on opening the sac that the bowel has actually perforated. To divide the constriction at the neck of the sac and either to pull down the loop or to perform an end-to-end anastomosis will be a very grave procedure on account of the almost certain risk of fouling the peritoneum; as a rule the less done in the way of disturbing the neck of the sac the better. The best plan is to see that free drainage is permitted, so that the separation of the sloughs can take place without risk to the adhesions which will have already formed between the neck of the sac and the bowel passing through it. The sloughing portion of the bowel should be cut off and the wound left widely open (see Fig. 111, *c*). In most cases the liquid contents of the bowel above can readily pass the constriction; sometimes however the

relief may be imperfect and, if the patient's condition be fairly good, it would then be quite legitimate to cover up the hernial wound and to make an incision in the middle line and anastomose the afferent and efferent ends of the loop with a Murphy's button so as to allow the proximal portion of the bowel to pass its contents freely into the distal while at the same time the sloughing portion is cut out of the circuit and left in the wound. This frees the patient from the obstruction, while no permanent artificial anus may form as the bowel between the stricture and the anastomosis may become obliterated.

CHAPTER XXIII.

HERNIA: THE TREATMENT OF THE INDIVIDUAL FORMS.

INGUINAL HERNIA.

Two main groups may be distinguished; in the *congenital* one the sac has existed from birth, in the *acquired* it is newly formed.

In congenital hernia, of which there are several varieties, the sac is the unobliterated portion of the funicular process of the peritoneum (see Fig. 112); in one form the entire process is patent and the peritoneal cavity above is continuous with that of the tunica vaginalis below; in others only a small funnel-shaped portion remains unobliterated above; lastly, the upper part alone may be obliterated so that a hernia pushing a fresh sac before it inverts the unobliterated portion of the funicular process below and may obscure the diagnosis; this last is the so-called "infantile hernia."

The division of inguinal hernia into the *oblique* and the *direct* forms is very important. The ordinary oblique inguinal hernia descends along the cord from the internal abdominal ring, and may be congenital or acquired; the direct form occurs to the inner side of the epigastric artery either stretching or perforating the conjoined tendon and is always acquired.

REDUCIBLE OBLIQUE INGUINAL HERNIA.—In inguinal hernia cure may follow the continued application of an efficient truss especially in the congenital herniæ of infancy and early childhood; if the hernia be kept reduced from the first, the funicular process may become obliterated, partly by natural development and partly by the continued pressure, and a cure is brought about. The cure of an acquired hernia is very much more doubtful.

In infancy.—In infants there is much difficulty in keeping a truss clean and in place, and perhaps the most satisfactory plan during the first year is to use a bandage instead of a truss; this is readily changed and may be washed and used again and, though not so efficient as a properly fitting truss in an older child, is valuable when properly used in the very young. The method usually adopted is to apply *a flannel bandage truss* as follows. The skin is first powdered with fullers' earth or equal parts of oxide of zinc, boracic acid and starch and a pad of boracic lint is laid

over the inguinal canal. A long strip of flannel two inches broad is taken and doubled in half. The loop is applied over the pad and the doubled strip is carried obliquely up across the iliac region on the opposite side to the hernia, then around the pelvis behind midway between the iliac crest and the great trochanter and the ends are brought forward and carried through the loop. The bandage is then drawn tight with the point at which the ends pass through the loop exactly over the internal ring. The mother now reduces the hernia—although an effort should always be made

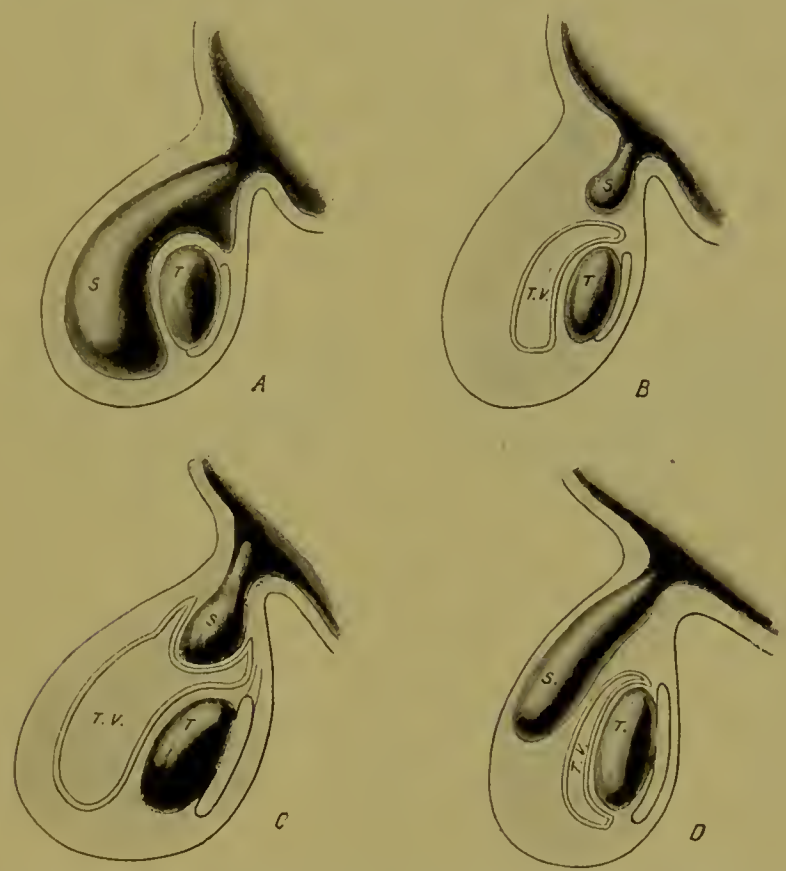


FIG. 112.—DIAGRAM OF THE VARIOUS TYPES OF OBLIQUE INGUINAL HERNIA. The arrangement of the peritoneum is shown with regard to the tunica vaginalis. *A* is the ordinary congenital type, *C* is the so-called "infantile hernia," *B* is the hernia into a patent funicular process, and *D* is the ordinary acquired form.

to keep it from descending during the changing of the truss—and, keeping it up by digital pressure over the ring, the pad is slipped in place, the bandage brought over it, the free ends carried round the fold of the perineum, brought up behind the buttock on the affected side and fastened to the horizontal limb of the truss; while this is being done enough traction is made to keep up the hernia. Unless the latter be very large it will generally do so but should it descend behind the bandage it means that either the pressure is not applied at the proper spot or that the band has not been drawn tight enough. In a bi-lateral hernia a similar bandage may be used for the opposite side. The child should be bathed

before the truss is removed, when it should be taken off and a fresh one applied; the old one can be washed and used again when dry.

A skein of worsted is often used instead of the flannel; one loop is brought over the seat of the hernia and the other end of the skein is passed round the pelvis as before, brought through this loop and the whole is tightened up until the point of junction is over the internal ring, when the free end of the skein is carried down between the legs and fastened to the horizontal limb of the skein as described above. The objection to the worsted is the expense, because this sort of truss in an infant must be changed several times a day and the worsted soon shrinks and becomes hard and uncomfortable, while the individual threads mark the skin and cause discomfort; on the whole the flannel is preferable. The difficulty with these trusses is to see that the mother or nurse thoroughly understands them. It is not sufficient to explain or even to demonstrate the method; the person in charge of the child must apply it herself on several occasions in the surgeon's presence.

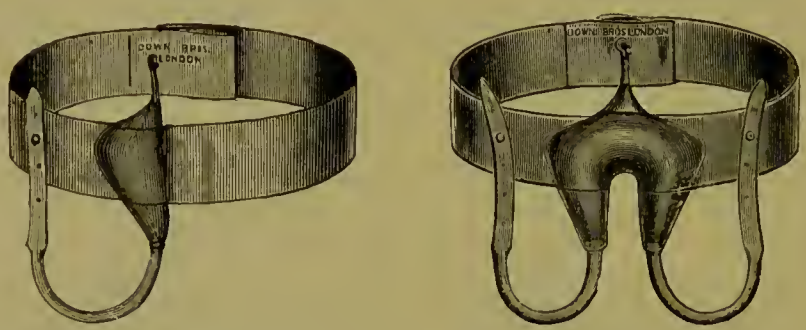


Fig. 113.—India-Rubber Trusses for Inguinal Hernia in Young Children. The pad is inflatable. The left-hand truss is for an unilateral, the right-hand for a bilateral hernia.

If trusses be employed in very young children they must be covered with indiarubber, and great care must be taken to keep the skin under them dry and clean. Two or three trusses should be provided for each case so that each one can be thoroughly cleaned after removal; the skin is washed and powdered (see p. 437) and boracic lint is applied between it and the pad of the truss. With a careful and intelligent mother who sees that the hernia does not descend during the changing of the truss the result may be very satisfactory; a careless one will often mismanage the child to such an extent that the skin gets sore under the pad and the truss has to be left off. Further, poor patients can only afford a single truss which soon gets foul and irritating. The ordinary spring truss, although constantly recommended, is not at all satisfactory in children under two years of age; the body is most difficult to fit, the child is growing rapidly, and the pad is usually either inefficient or exerts injurious pressure.

When the abdominal ring is very large a flannel truss will not act; in an infant, in whom the conditions are unfavourable for a radical cure, the truss shown in Fig. 113 may be tried; this consists of a broad indiarubber band encircling the pelvis, to the front of which are fixed one or two pads of india-

rubber, according to the nature of the case, distended with glycerine, water or air,—the latter by preference,—and kept in position by indiarubber perineal straps.

If the flannel truss keeps up the hernia efficiently it should be worn continuously for eighteen months or two years and then left off; if the hernia has now disappeared, well and good, if not, an ordinary spring truss should be worn for about another year and then radical cure (see p. 441) should be done if the hernia still comes down.

Should the truss fail to keep up the hernia *radical cure* must be performed, but we have already given reasons for deferring this until the child is two or three years old (see p. 422); we have however operated on a number of infants from nine to eighteen months old for the reason given above with excellent results. The steps of the operation are detailed on p. 441; after it we fix a small strip of gauze along the line of incision with collodion and do not use any bandages or other dressings as they only get soaked with urine. The collodion dressing is changed as frequently as may be necessary and after the first day the line of incision is also painted with collodion before the gauze is applied so as to keep it impervious.

In adults.—The remarks already made upon the question of a radical cure *versus* a truss (see p. 422) apply in their entirety to inguinal hernia.

Trusses.—Should it be decided that the patient is to wear a truss,—and, even if he decides on operation, he should wear one until it is performed,—the following points must be attended to. In ordering the truss the circumference of the pelvis is measured from the centre of the external ring to a point midway between the top of the great trochanter and the crest of the ilium and then horizontally around the pelvis on this level and back again to the centre of the ring. The sex, occupation and social habits of the patient should be notified, together with some idea of the size of the ring and the amount of pressure required to keep up the hernia. It is also well to state whether the patient be fat or not and whether a perineal band will be required; this as a rule is only essential when the abdomen is very flat as in the opposite condition there is no tendency for the truss to slip up. The pad should be as flat as possible and just large enough to overlap the ring in all directions and to press on the lower end of the inguinal canal. It must be so arranged that the vas is not pressed upon and, if the ring be large and considerable pressure be required or if the patient be the subject of a misplaced testicle, it is well to employ the horse-shoe pad designed by the late Professor Wood, which avoids pressure on the cord (see Fig. 109). Wood's horse-shoe truss is also useful in direct herniæ where the ordinary truss is very apt to press upon the cord; it is also suitable for those who are very susceptible to pressure and who rapidly develop varicosity of the veins of the cord therefrom. The ordinary spring truss takes its purchase behind over the sacrum and should pass round the body midway between the iliac crest and the top of the great trochanter. It should lie flat against the skin everywhere except near the junction of the spring with the pad.

Special trusses are used for cases of retained testicle complicating a hernia, for scrotal hernia (see Fig. 114) and for irreducible hernia (see Fig. 110), but in our opinion these are very rarely called for; in all these cases, unless there is some very serious contra-indication, a radical cure should be performed. When the muscles are very lax, the subjects very fat and the herniæ very large the radical cure may not be permanent; but even then it is of great value as it allows the patient to wear an ordinary truss.

When a radical cure is not done for a scrotal hernia the form of truss used is triangular and with a very strong spring,—the so-called "rat-tailed truss" (see Fig. 114). A strap passes from the inferior angle of the pad across the perineum and is fastened to the spring on the same side of the body as the hernia. The perineal band in this truss is meant to exert direct pressure upon the canal, while that in the ordinary form merely prevents the pad from slipping up.

In cases of hernia complicating undescended testicle a cup-shaped truss is often employed to receive the testicle whilst its rim keeps up the hernia.

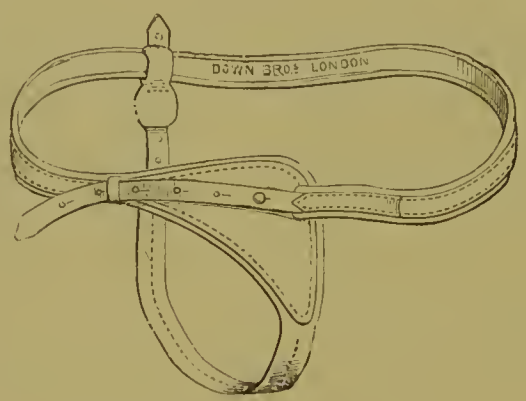


Fig. 114.—Truss for Scrotal Hernia.

We consider however that it is always advisable to operate on these cases partly in order to perform a radical cure of the hernia and partly to remedy the undescended testicle and to our minds it is open to question whether a truss should be worn at all. The hernia, which is practically always present, helps the descent of the testicle and the neck of the sac is wide and there is little risk of strangulation. When the child can be under close observation we are therefore inclined to allow some time to elapse before operating and not to recommend a truss to be worn at all in order to get the testicle to descend as low as possible.

The first point in applying a truss is to reduce the hernia. The patient lies flat on a couch, and the thigh on the affected side is flexed and rotated inwards. The neck of the sac is then grasped between the left thumb and forefinger and pushed firmly downwards and inwards; the bulk of the tumour is then grasped in the palm of the right hand and the swelling compressed and gradually squeezed up towards the inguinal ring. Compression is first employed in order to empty the contents of the bowel, and when this has been done the contents of the sac are returned into the

abdomen by steady upward pressure. Many patients are very expert at this. After the hernia has been reduced, the thumb and two fingers are placed firmly over the canal so as to prevent it coming down, the truss is slipped round the body and the pad is placed over the canal and the internal abdominal ring. The management of the truss has been already detailed (see p. 425).

Radical cure.—Inguinal hernia is the form most suited for the "radical cure" operation, and is that in which the operation is most successful.

Many operations have been introduced for the radical cure of inguinal hernia, the details as well as the principles of dealing with the hernia varying widely. For our own part, we usually employ a nondescript operation (see p. 450) taking points from various methods. Before describ-

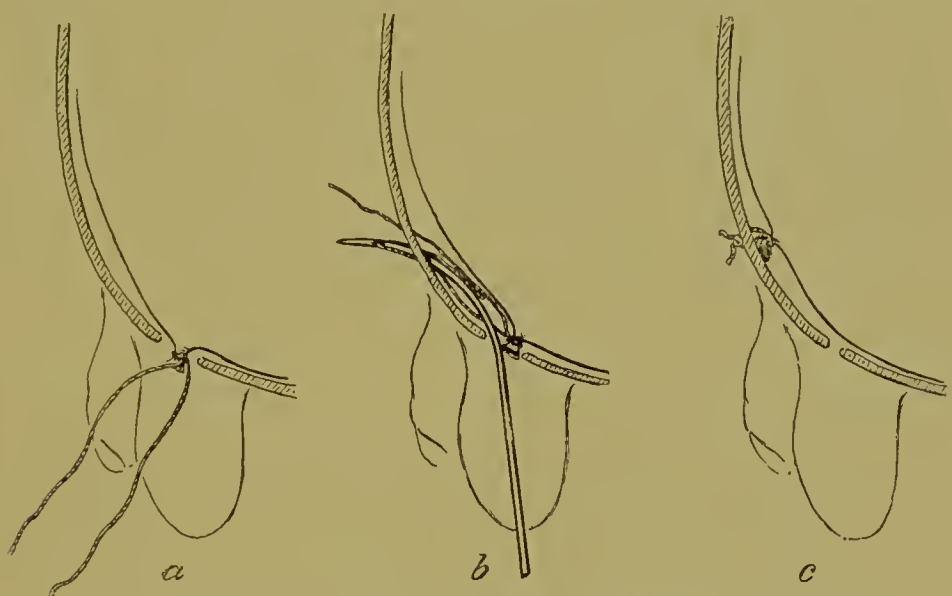


FIG. 115.—METHOD OF TREATING THE NECK OF THE SAC BY LIGATURE IN THE RADICAL CURE OF HERNIA. In *a* the neck of the sac has been ligatured and the sac itself cut away, *b* and *c* show how the ends of the ligature around the neck of the sac are passed through the abdominal walls, so that when they are tied the peritoneum is drawn flush over the ring and all trace of a hernial dimple is obliterated.

ing the methods we may point out the essential principles of the operation, which are two in number, viz.: 1. To deal effectually with the hernial sac, and 2. to close the canal along which the hernia has come. We shall then describe the operation for the acquired, the congenital and the direct forms of hernia.

1. **The treatment of the hernial sac.**—It is hardly necessary to mention that, when a hernia is reduced into the abdomen, the sac remains behind. An essential part of any operation is the complete obliteration of this structure for, if it be left behind, the hernia will come down into it again however the canal has been treated. It is most important that not only should the whole sac be removed, but that not even a dimple should be left at its neck.

Obliteration of the sac may be effected in several ways. The one most

often employed is *complete removal of the sac and ligature of the neck.* A needle carrying a double thread is passed through the peritoneum just above the neck of the sac, cleared both of its contents and its coverings, and these threads are tied on each side and the sac cut away. An end of each thread is left long, the peritoneum is separated from the muscles by the finger passed up through the canal and the ends of the ligatures are then carried through the abdominal muscles from behind forwards at a point well above the ring so as to drag up the stump well away from the hernial orifice (see Fig. 115).

This is a very efficient method, but it must be done thoroughly. If the sac be ligatured a little below the neck, a funnel-shaped projection is left into which a hernia may again find its way. It is absolutely essential to remove the neck as well as the body of the sack and in order to do this it is necessary in most cases to slit up the external oblique. The vas must be separated from the neck of the sac; this is easily done with the finger. The most important point requiring attention in this method is to see that none of the contents are adherent to the neck of the sac or protrude through it, as otherwise they may be injured. The neck of the sac must also be most carefully cleared; neglect of this precaution has led to injury of the bladder by the ligatures; this is only likely to happen however in a direct inguinal or a femoral hernia. In the ordinary oblique inguinal form the bladder is usually not in evidence.

Another efficient method is *torsion of the sac.* The neck is cleared, the sac is opened, so as to make sure that there are no adhesions either in the sac or at the neck,—a very important point,—and the fundus of the sac is seized with forceps and twisted up tightly, the cord being held out of the way. In this way the upper end of the sac can be obliterated absolutely; indeed a very large amount of the peritoneum can be stripped off the abdominal wall. Previous to twisting the sac, the finger is introduced between the transversalis muscle and the peritoneum and a little bed is formed above and to the outer side of the neck of the sac for the reception of the sac when twisted. The twisting is carried on until the sac gets into a knot, when the forceps are pushed up into the bed previously prepared and, when the muscular wall is strong, the mere pressure of the abdominal wall prevents untwisting. The chief objections urged against the method are the possibility of the sac unwinding and with lax abdominal walls this may certainly occur and here ligature of the sac is preferable. Another objection is that the sac does not always become obliterated and a collection of fluid occurs in it. This is quite a rare occurrence and can probably be avoided by opening the lower end of the sac. A third objection is that, should the wound suppurate, the sac may slough; this has certainly occurred, but is much more rare than might be expected, and these operations should not be accompanied by suppuration. We employ the method very often for the herniæ of children where the damage to the abdominal walls should be as slight as possible.

Among other methods of dealing with the sac are Macewen's, in which the sac is pursed up, and Kocher's, in which the twisted sac is brought out through the external oblique (see Fig. 116). In all cases, if the sac be not cut away, it must be removed from the inguinal canal; to leave a twisted or a pursed-up sac in the inguinal canal is to leave a tissue which prevents the proper closure of the canal and which of itself is not a satisfactory barrier to the descent of the hernia.

In direct hernia the condition is different, and frequently neither of these methods can be employed. As a rule there is no narrow neck to the sac,

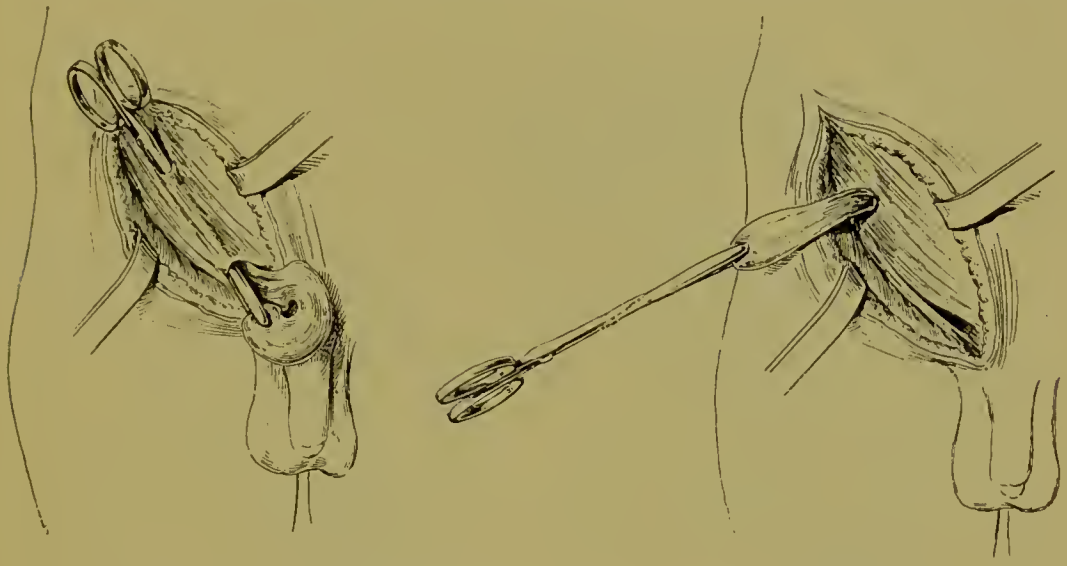


FIG. 116.—KOCHER'S METHOD OF TREATING THE SAC IN RADICAL CURE OF INGUINAL HERNIA. The finger is first passed up the canal behind the external oblique and a long pair of forceps are thrust through the latter on to the finger and guided by it down the canal and out at the external ring, where the fundus of the sac is firmly seized, as shown in the left-hand figure. The forceps are then withdrawn carrying the sac with them, as seen in the right-hand figure. Finally the fundus of the sac is laid down on the outer surface of the external oblique, directly over the inguinal canal, and secured firmly in place by a series of sutures which first pass through the muscle, Lembert-fashion, on one side of the sac, then right through the sac, then finally through the external oblique, again Lembert-fashion, on the opposite side of the sac. When these sutures are tied the sac is immovably incorporated with the abdominal wall. If preferred, the neck of the sac may be secured to the opening in the external oblique after the fundus has been cut away.

which is a mere protrusion of the peritoneum, and it is impossible either to twist or to purse up the neck sufficiently to ligature it. Moreover, in the oblique form also, when the cæcum is in the sac, portions of the latter must be put back with the intestine and no satisfactory neck is left. In both cases closure is best effected by cutting away the sac altogether and stitching up the peritoneum as in an ordinary laparotomy.

2. **The methods of dealing with the canal.**—This question is very important, and is one about which there is very reasonable difference of opinion. The first question is whether steps should be taken to close the canal at all. This depends, we believe, on the age of the patient and on the condition of the abdominal walls. There is no doubt that the essential point in the operation of radical cure is the complete obliteration of the sac, but, when the abdominal walls are lax and atrophied or stretched by the

existence of a large hernia, a fresh protrusion of peritoneum is very liable to occur unless some approximation of the sides of the canal be also effected. In children, on the other hand, the hernia is often due to the existence of an unobliterated portion of the tunica vaginalis and not to muscular inefficiency, and a large number of cases are cured by simple obliteration of the sac without suture of the inguinal canal. The arrangement of the muscles is such that they tend to close the inguinal canal as they contract, and the insertion of stitches may interfere with this. In young children, therefore, unless the hernia be large and the canal widely dilated, it is not necessary to

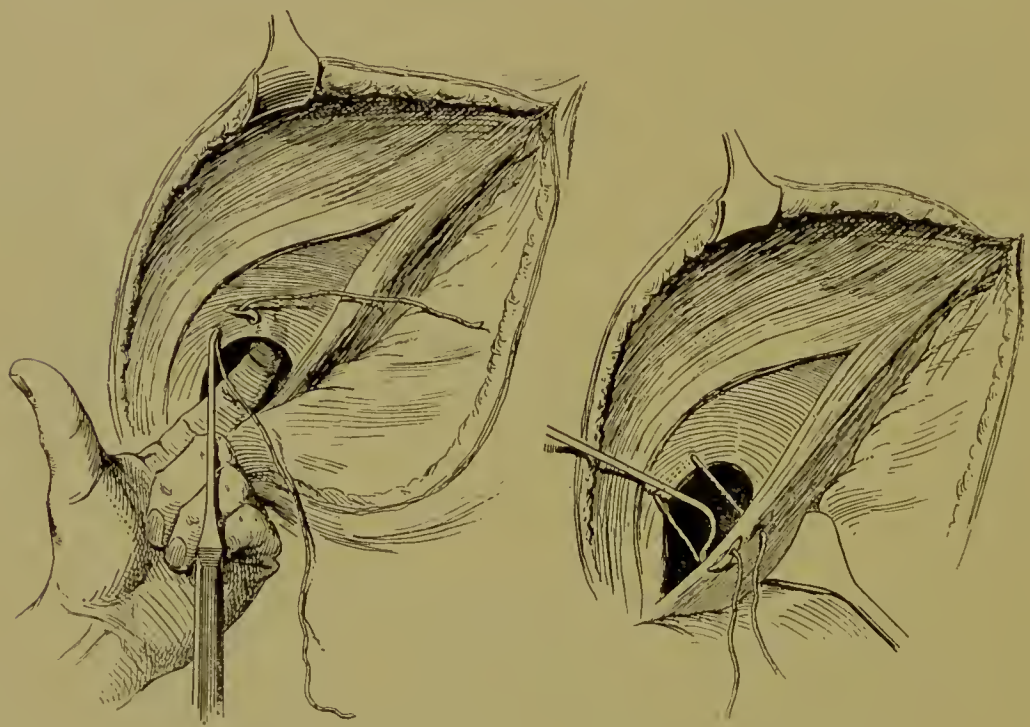


FIG. 117.—MACKWEN'S METHOD OF CLOSING THE INGUINAL CANAL IN RADICAL CURE OF HERNIA. The left-hand sketch shows the method of passing the suture through the conjoined tendon, while the right-hand one shows the ends of this suture passed, one through the fascia lata of the thigh just below Poupart's ligament, while the other (the inner or lower end) is passed through the ligament itself. In Prof. Macewen's own description (see p. 445) both ends are passed through the ligament.

insert stitches in the canal; with the obliteration of the sac the essential part of the operation is completed, and, in order to avoid undue separation of the muscles, we generally twist the sac (see p. 442). It is well however to put a few stitches in the external abdominal ring, which is unduly dilated by the hernia, and which is also to some extent torn up by the manipulations during the operation and, as this is a tendinous opening, its closure by muscular action is not so complete as is the case with the internal ring. When however the hernia is large, when the muscles are thinned and spread out over the sac, and especially in old or fat people and in direct hernia, it is necessary to bring the sides of the canal together by stitches besides obliterating the sac, and this can be done in a variety of ways.

In Macewen's method (see Fig. 117), which is best suited for cases with fairly strong muscular walls, the cord is kept out of the way and stitches are inserted through the conjoined tendon or the adjacent portion of the internal oblique and transversalis, or through both, on the one side and through Poupart's ligament on the other, and the former structures are pulled in front of the cord and approximated to the latter; usually one or two mattress sutures suffice for this purpose.

Macewen's operation.—The operation is described by its author in the *British Medical Journal*, December 10th, 1881, in the following words:—

"*A. The Formation of a Pad on the Abdominal Surface of the Circumference of the Internal Ring.* (1) Free and elevate the distal extremity of the sac, preserving along with it any adipose tissue that may be adherent to it; when this is done, pull down the sac, and, while maintaining tension upon it, introduce the index finger into the inguinal canal, separating the sac from the cord and from the parietes of the canal.

"(2) Insert the index finger outside the sac till it reaches the internal ring; there separate with its tip the peritoneum for about half an inch round the whole abdominal aspect of the circumference of the ring.

"(3) A stitch is secured firmly to the distal extremity of the sac. The end of the thread is then passed in a proximal direction several times through the sac, so that, when pulled upon, the sac becomes folded upon itself, like a curtain.

"The free end of this stitch, threaded on a hernia needle, is introduced through the canal to the abdominal aspect of the fascia transversalis, and there penetrates the anterior abdominal wall, about an inch above the upper border of the internal ring. The wound in the skin is pulled upwards, so as to allow the point of the needle to project through the abdominal muscles without penetrating the skin.

"The thread is relieved from the extremity of the needle when the latter is withdrawn. The thread is pulled through the abdominal wall: and when traction is made upon it, the sac, wrinkling upon itself, is thrown into a series of folds, its distal extremity being drawn furthest backwards and upwards. An assistant maintains traction upon the stitch until the introduction of the sutures into the inguinal canal; and when this is completed, the end of the stitch is secured by introducing its free extremity several times through the superficial layers of the external oblique muscles. A pad of peritoneum is thus placed upon the abdominal side of the internal opening, where, owing to the abdominal aspect of the circumference of the internal ring having been refreshed, new adhesions may form.

"*B. The Closure of the Inguinal Canal.* The sac having been returned into the abdomen and secured to the abdominal circumference of the ring, this aperture is closed in front of it in the following manner—The finger is introduced into the canal, and lies between the inner and lower borders of the internal ring, in front of and above the cord. It makes out the position of the epigastric artery so as to avoid it. The threaded hernia needle is then introduced, and, guided by the index finger, is made to penetrate the conjoint tendon in two places; first, from without inwards, near the lower border of the conjoint tendon; secondly, from within outwards, as high up as possible on the inner aspects of the canal. This double penetration of the conjoint tendon is accomplished by a single screw-like turn of the instrument. One single thread is then withdrawn from the point of the needle by the index finger; and when this is accomplished, the needle, along with the other extremity of the thread, is removed. The conjoint tendon is therefore penetrated twice by this thread, and a loop left on its abdominal aspect.

"Secondly, the other hernia needle, threaded with that portion of the stitch which comes from the lower border of the conjoint tendon, guided by the index finger in the

inguinal canal, is introduced from within outwards, through Poupart's ligament, which it penetrates at a point on a level with the lower stitch in the conjoint tendon. The needle is then completely freed from the thread and withdrawn.

"Thirdly, the needle is now threaded with that portion of the catgut which protrudes from the upper border of the conjoint tendon, and is introduced from within outwards through the transversalis and internal oblique muscles, and the aponeurosis of the external oblique at a level corresponding with that of the upper stitch in the conjoint tendon. It is then quite freed from the thread and withdrawn.

"There are now two free ends of the suture on the outer surface of the external oblique, and these are continuous with the loop on the abdominal aspect of the conjoint tendon. To complete the suture, the two free ends are drawn tightly together and tied in a reef knot. This unites firmly the internal ring.

"The same stitch may be repeated lower down the canal if thought desirable. In adults it may be well to do so when the gap in the abdominal parietes is wide. The pillars of the external ring may likewise be brought together.

"In order to avoid compression of the cord, it ought to be examined before tightening each stitch. The cord ought to lie behind and below the sutures, and be freely moveable in the canal. It is advisable to introduce all the necessary sutures before tightening any of them. When this is done, they might be all experimentally drawn tight, and maintained so, while the operator's finger is introduced into the canal to ascertain the result. If satisfactory they are then tied, beginning with the one at the internal ring, and taking up in order any others which may have been introduced. In the great majority of cases the stitch in the internal ring is all that is required.

"During the operation the skin is retracted from side to side, to bring the parts into view, and to enable the stitches to be fixed subcutaneously. When the retraction is relieved, the skin falls into its normal position, the wound being opposite the external ring. The operation is therefore partly subcutaneous."

Bassini's operation.—On the other hand, a more popular method nowadays and one better suited for old patients and those in whom the muscular wall is feeble is Bassini's (see Fig. 118). This involves a more complete closure of the canal and to do it the external oblique tendon is slit up sufficiently to fully expose the whole canal, and then, the cord being hooked down out of the way, the lower edges of the internal oblique, the transversalis and the conjoined tendon are defined and separated from the peritoneum by the finger, and a series of sutures are inserted so as to bring this edge into close apposition with Poupart's ligament throughout, except at the outer end where just enough room is left for the cord to emerge. This may be done by a continuous suture but we prefer to employ three or four mattress sutures similar to those recommended by Macewen. The first stitch is inserted as high up the internal ring as possible, so as just to allow the cord room to emerge; if the veins be at all large we sometimes excise them as in the operation for varicocele. The lowest suture is in the conjoined tendon. The vas is then laid down in place and the divided edges of the external oblique and the pillars of the external ring are carefully sutured over it throughout with chromicised catgut, just leaving room for the cord to emerge at the inner extremity. There is no doubt that this is a much more effectual operation in these particular cases than Macewen's and is the most suitable for all cases where the canal has to be diminished in size.

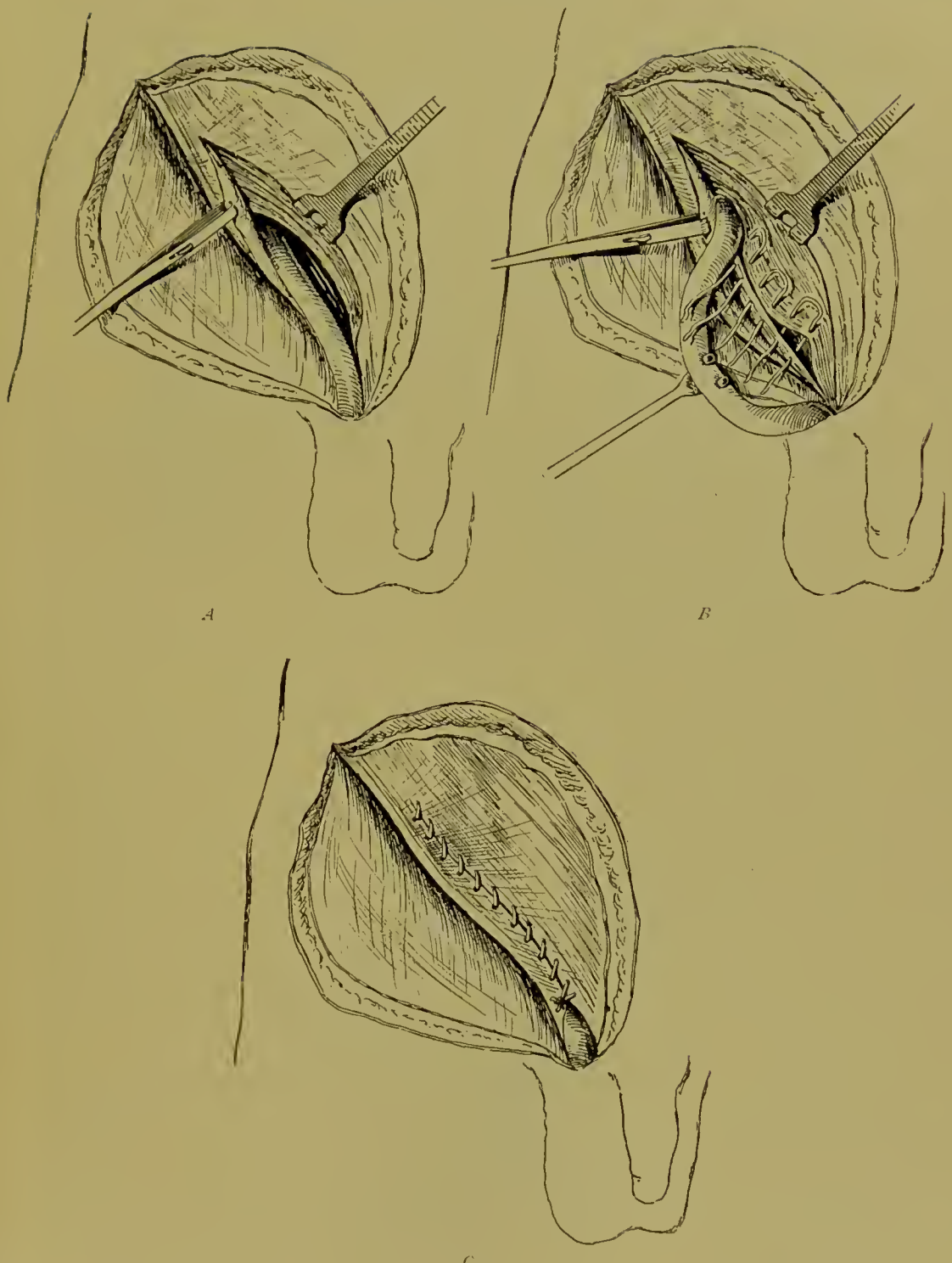


FIG. 118.—BASSINI'S RADICAL CURE OF INGUINAL HERNIA. The three chief stages of the operation are illustrated. In *A* the external oblique has been slit up to expose the internal ring fully. In *B* the cord is hooked down out of the way and the lower edge of the internal ring is approximated behind it to Poupart's ligament, leaving just room enough for the cord to emerge at the outer end. In *C* the cord has been laid down in position and the cut edges of the external oblique sutured together over it, leaving just room for its emergence below. This is better done by interrupted sutures. It will be noticed that the area of operation is exposed by turning down a flap (see p. 450).

Halsted's operation.—A method employed by a good many surgeons is that known as Halsted's (see Fig. 119), which is described by its author in the following words[1]:—

> "Instead of trying to repair the old canal and the internal abdominal ring, I make a new canal and a new ring. The new ring should fit the cord as snugly as possible, and the cord should be as small as possible. The skin incision extends from a point about 5 cm. above and external to the internal ring to the spine of the pubes. The subcutaneous tissues are divided, so as to expose clearly the aponeurosis of the external oblique and the external ring. The aponeurosis of the external oblique, the internal oblique and transversalis and the transversalis fascia are cut through from the internal abdominal ring to a point about 2 cm. above and external to the internal ring. The vas deferens and the blood-vessels of the cord are isolated. *All but one or two of the veins of the cord are excised.* The sac is carefully isolated and opened, and its contents replaced. A piece of gauze is usually employed to replace and retain the intestines. With the division of the muscles and transversalis fascia, the so-called neck of the sac vanishes. There is no longer a constriction of the sac. The communication between the sac and the abdominal cavity is sometimes large enough to admit one's hand. The sac having been completely isolated and its contents replaced, the peritoneal cavity is closed by a few fine silk mattress sutures, sometimes by a continuous suture. The sac is cut away close to the sutures. The cord in its reduced form is raised on a hook out of the wound, to facilitate the introduction of the six or eight quilt sutures, which pass through the aponeurosis of the external oblique, and through the internal oblique and transversalis muscles and transversalis fascia on the one hand, and through the transversalis fascia and Poupart's ligament and fibres of the aponeurosis of the external oblique on the other. The two outermost of the deep quilt sutures pass through muscular tissues, and the same tissues on both sides of the wound. They are the most important sutures, for the transplanted cord passes out between them. If placed too close together, the circulation of the cord might be imperilled, and if too far apart the hernia might recur. They should, however, be near enough to each other to grip the cord. The precise point to which the cord is transplanted depends upon the condition of the muscles at the internal abdominal ring. If in this situation, they are thick and firm, and present broad raw surfaces, the cord may be brought out here. But if the muscles are attenuated at this point, and present their cut edges, the cord is transplanted farther out. The skin wound is brought together by an uninterrupted suture, which is withdrawn after two or three weeks. The transplanted cord lies on the aponeurosis of the external oblique, and is covered by skin only."

Choice of operation.—The foregoing are the three chief methods of dealing with the inguinal canal. We very seldom use Halsted's method but we employ the others according to circumstances. In young children with quite strong muscles we do not interfere with the deeper muscles at all; in adults with small herniæ and fairly strong muscles we generally employ Macewen's method; whereas in older people, or when the canal is widely dilated and the muscles feeble, we prefer Bassini's operation. In every case the external ring should be diminished sufficiently to just allow the cord to emerge without pressure on the veins which may be removed as in Halsted's operation if it be desired to suture the external ring very completely.

[1] See *Johns Hopkins Hosp. Rep.*, Vol. II.; *Surg. Fasciculus*, No. 1; *Ann. of Surgery*, 1893, Vol. I., p. 542.

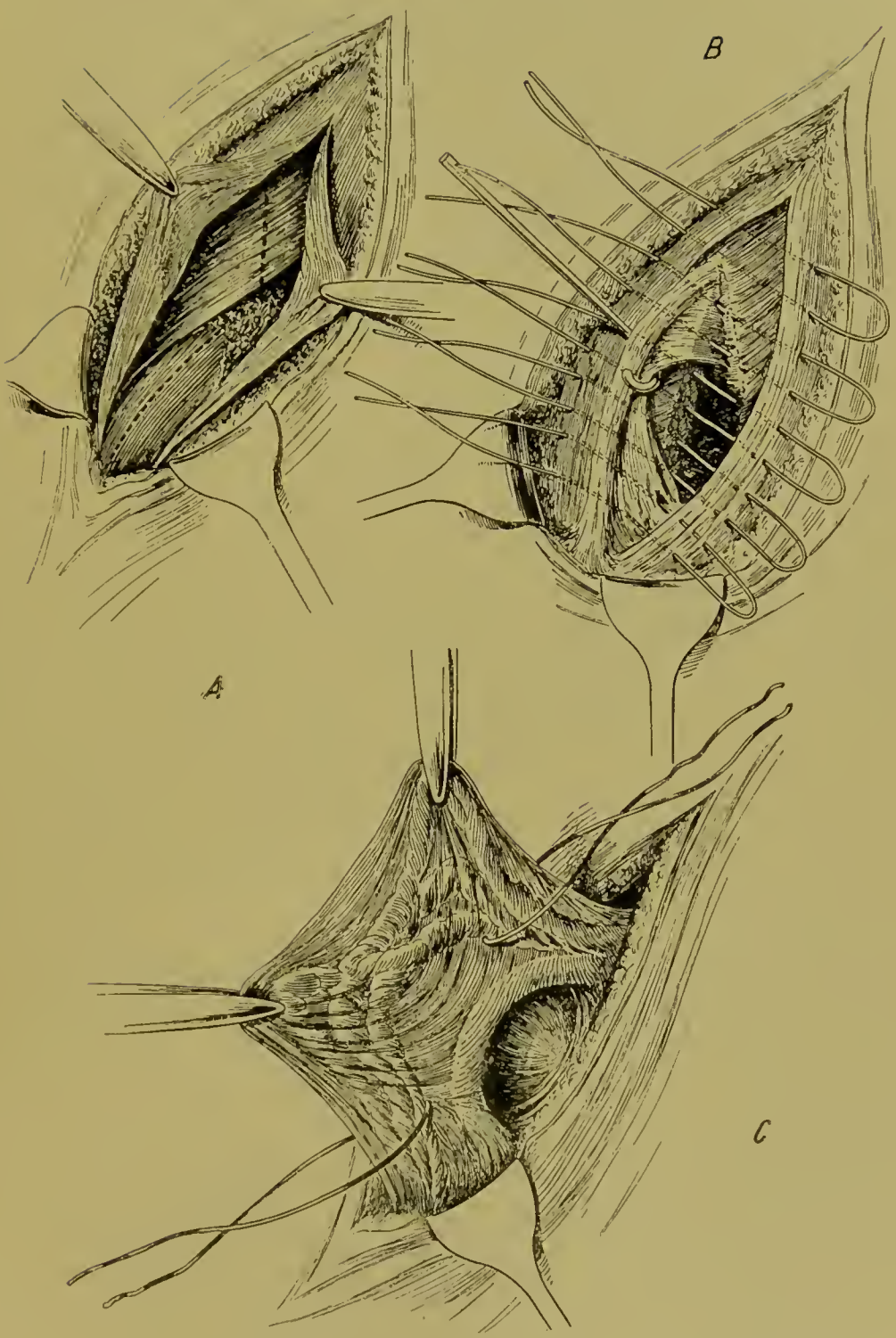


FIG. 119.- HALSTED'S RADICAL CURE OF INGUINAL HERNIA (after Bloodgood). The operation is described fully in the text (see p. 448). *A* shows the exposure of the sac and the line of incision of the internal oblique and transversalis *C* shows the removal of the spermatic veins, while *B* shows the method of passing the sutures.

Fairly thick catgut is a good material for the neck of the sac while we usually employ silk for bringing the walls of the canal together as it remains unchanged longer and seldom causes trouble; some surgeons use kangaroo tendon or thick chromicised catgut. The probability is that the stitches themselves do not hold very long because there must be some pull upon them and they are almost sure to get loose. The effect of the operation is rather to produce adhesion between the adjacent surfaces of the internal and the external oblique, than any firm union of the edge of the internal oblique and transversalis to Poupart's ligament. We do not therefore think that the material for the sutures is of great importance. For the external oblique we now usually employ chromicised catgut; at one time we used silkworm gut, but this is non-absorbable and its sharp ends prick the patient and it is especially troublesome when a truss is necessary subsequently. For the same reason silver wire is quite unsuitable.

The following are the steps of the operation we perform for radical cure of an oblique inguinal hernia in an adult. The thigh is flexed and abducted and the parts thoroughly shaved and disinfected in the usual manner. It is most important to have the male genitals kept out of the way and the simplest plan is to fasten the prepuce to the skin of the opposite thigh with a stitch: sterilised towels may then be arranged to cover them. When this seems undesirable a sterilised sheet of fairly thick lead may be moulded over the organs which are thus kept out of the way by the weight of the lead, over which the towels are placed. A curved incision with its convexity upwards is made with its extremities lying just over Poupart's ligament, the lower near the symphysis pubis and the upper above the centre of the ligament, so as to turn down a flap which will prevent the line of incision corresponding to the line of suture of the muscles; the curve should be a good bold one so as to expose the whole of the parts concerned well above and outside the internal ring (see Fig. 118). This is deepened until the external oblique is exposed, when the flap is peeled well down so as to expose the whole area and part of the fascia lata below Poupart's ligament. The finger is hooked underneath the cord and its coverings just outside the external abdominal ring, the external spermatic fascia is divided from its attachment to the margins of the former and the external oblique is separated from the cord and the internal oblique by sweeping first the handle of the knife and then the finger between the two structures.

A longitudinal incision is now made through the external spermatic and cremasteric fasciæ, the constituents of the cord are spread out and the sac, which forms a whitish band running down the centre and in front of the vas, is identified. The part of the sac most readily recognised is its lower edge and when this is found the fascial structures are divided down to it, its margin is seized and, with the finger and the handle of the knife, it is easily stripped up from the constituents of the cord; a good plan is to seize the lower end in a pair of Spencer Wells forceps, pull it forwards and steady it while it is being isolated well up beyond the neck. The assistant

takes charge of the vas and the other constituents of the cord. When the neck of the sac is thoroughly cleared, the finger is pushed up between the peritoneum and the abdominal muscles so as to form a bed into which the sac or its stump will be received.

The next point is whether the external ring shall be slit up (see p. 442). *In young adults* who have only a small hernia and strong muscles we leave this structure untouched and proceed, after opening the sac and ascertaining that it is empty, to twist it and push it up into the bed formed for it (*vide supra*). On the other hand *when the hernia is large* and the muscles

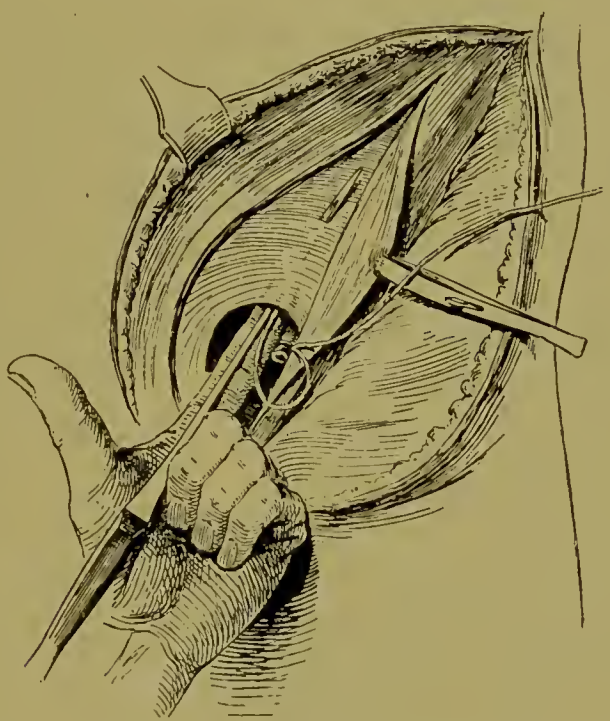


FIG. 120.—METHOD OF DEALING WITH THE NECK OF THE SAC AFTER LIGATURE. The ends of the ligatures upon the neck of the sac are threaded in turn upon a nævus needle and carried through the abdominal wall as shown in the figure. When the two threads, which are brought out close together, are tied, the neck of the sac is drawn up well above and to the outer side of the internal ring (see also Fig. 115)

are weak, it is evident that some repair of the canal is necessary and we slit up the external ring by nicking its upper end and separating the tendinous fibres with the finger until the internal ring is freely displayed. The pillars of the ring are firmly retracted. When the external ring has been slit up it is best to transfix, ligature, and cut away the sac. The ends of the ligature are left long, threaded in turn on a nævus needle which is guided by the forefinger of the left hand pushed into the bed formed behind the transversalis, and carried through the abdominal muscles from behind forwards about an inch above and to the outer side of the internal ring. The ends of the ligature are now pulled tight, tied and cut short (see Fig. 120).

In the cases in which the sac is twisted its neck is seized between the finger and thumb of the left hand and the fundus is grasped in Spencer Wells forceps and is twisted up until it forms a little knot, when it is pushed up into its bed beneath the transversalis and left.

After the sac has been disposed of in one of these ways, the repair of the canal is undertaken. When we do not consider it necessary to slit up the external ring and the muscles are strong we do not generally do anything to the canal. When however it is advisable to diminish its width we employ either Macewen's (see p. 445) or Bassini's plan (see p. 446). In either we use silk mattress sutures as advocated by Macewen. When we employ Macewen's method we vary his procedure slightly. After the suture has been inserted through the conjoined tendon in the ordinary manner, the needle is threaded with one of the free ends and passed beneath Poupart's ligament, brought forwards through the fascia of the thigh, unthreaded and withdrawn, after which the other end is threaded into it and it is passed about an inch lower down through the fibres of the external oblique tendon just above the ligament. When the two ends of the ligature are tied, the edge of Poupart's ligament lies in the loop of the stitch and the result seems to us more satisfactory than when both ends are passed through the ligament itself. In passing the ligatures it is most important to see that nothing but the conjoined tendon is taken up; it has happened that the bladder has been perforated by the ligature from imperfect clearing of the posterior surface of the tendon.

The external oblique is then united by interrupted sutures, the external ring being diminished in size to the required extent, the bleeding is arrested, the flap stitched by a continuous suture and the operation is complete. In very fat subjects we put a small drainage tube in the upper angle of the wound for two days to avoid accumulation of serum; in the great majority no drain is necessary. To approximate the deeper parts we usually employ sponges incorporated in the dressing (see Part I., p. 170). The bandage is a double spica and we usually apply a broad piece of elastic webbing outside the first dressing to act as a support to the operation area and also to reinforce the sponge pressure. The elastic bandage is applied outside the ordinary bandage as shown in Fig. 121. If the dressing become soiled, or there be excessive bleeding, it should be removed, and usually at any time after the first two days a collodion dressing and a pad of salicylic wool outside can be applied. To prevent the dressing being soiled with urine in the male we take a piece of jaconet with a hole in it for the penis and fasten it over the lower edge of the dressing so that any urine is caught by it; it must not however extend too high as otherwise it prevents the drying of the deeper dressings which is important for healing.

In very young children it is best to fix on the first dressing with collodion. This diminishes the risk of soiling and, if the child be turned over to pass water, there is little risk of soiling the dressing which in any case is readily renewed. We usually keep our patients in bed for three weeks after the

operation and for the first few days after they are up they feel more comfortable if they have the support of a firm calico or elastic bandage over a pad of wool, but this should be given up in a week or two. No truss or support of any kind should be worn after a radical cure operation; we consider this an extremely important point, the contravention of which is in our opinion one of the chief causes of failure. Support is quite unnecessary

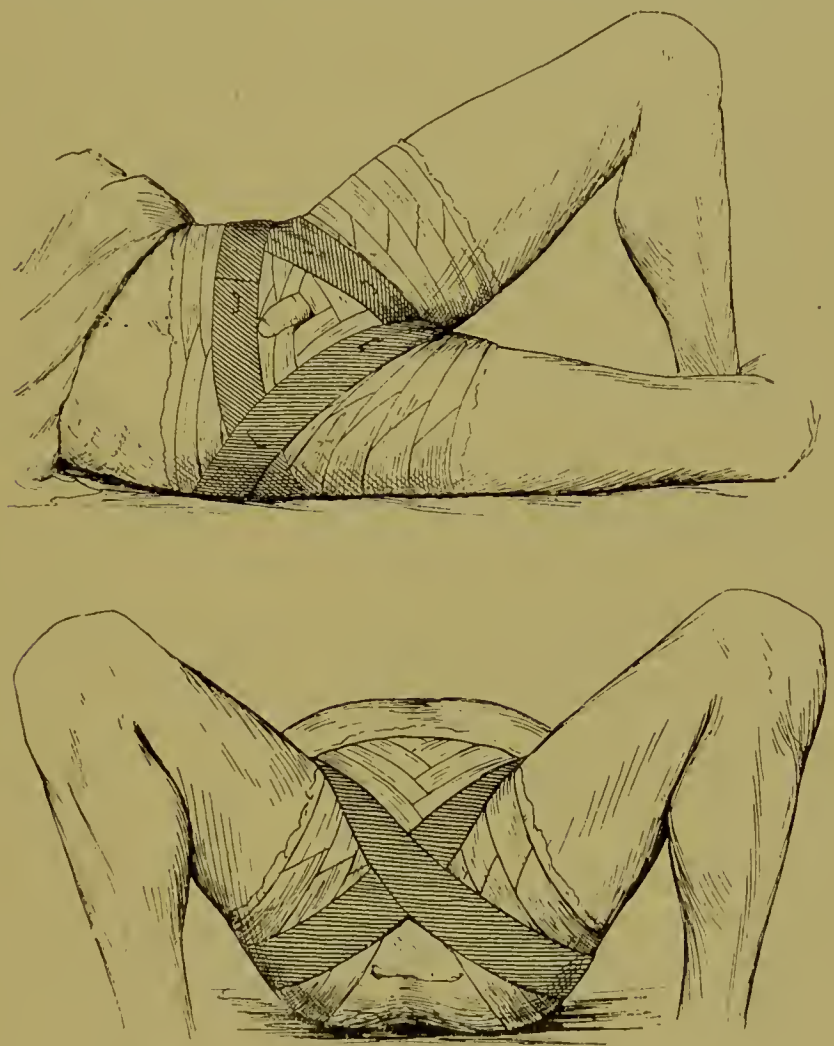


FIG. 121.—METHOD OF EMPLOYING ELASTIC PRESSURE TO KEEP DRESSINGS IN POSITION. The sketch shows a front view of the dressings we usually apply after hernia operations, and illustrates the method of applying the elastic webbing; this is stretched fairly tight and is still further prevented from slipping by the safety pins shown in the figure.

unless indeed the patient has a bad cough, when an elastic spica is preferable to a truss because truss pressure however light leads to softening and thinning of the cicatricial tissue and so to failure of the operation. When however the operation has been done simply to effect the reduction of the hernia with the view of enabling the patient to wear a truss the case is different. The patient is kept on a fluid diet for two or three days and a saline purge is given at the end of the second day. If there be much flatulence before

that time, washing out the rectum with a warm water enema will probably relieve it effectually.

Complications.—The most important complication occurring during the treatment of the case is suppuration, which takes place very occasionally and varies according to the method of the operator and is generally attributed to faulty disinfection of the deep stitches. This may be so, but we are by no means sure that the infection is not equally if not more often due to incomplete disinfection of the skin or some faulty manipulation on the part of the surgeon or his assistants. However that may be, suppuration after radical cure very seriously interferes with the result of the operation. Separation of the stitches takes place in practically all cases where suppuration occurs, and the wound does not heal until this has happened; as this may take a long time the inguinal canal is infiltrated with inflammatory cells and converted into a cicatricial tissue which yields gradually before the weight of the abdominal contents. Hence the sooner the septic stitches are removed the better, and we would advise that, whenever the accident has occurred, the wound should be opened up, either by turning aside the original flap or, in some cases better, by a second smaller incision over Poupart's ligament, so as to expose the lower end of the deep stitches which are found and removed; in this way much time is saved.

It sometimes happens that, long after the wound has healed and the patient has been about, a small vesicle forms in the scar and leaves a sinus leading down to a stitch; this has happened even many months after the operation and the sinus will not heal until the stitch concerned has escaped or has been removed. The cause of this is not quite clear. It may be some peculiar quality of silk or it may be due to some slow-growing non-pyogenic organism introduced along with the silk at the operation, or again it is conceivable that the tissues around the stitch become infected from the blood at a later period when the patient's resisting power is not good. Fortunately in our experience at any rate, this is an excessively rare occurrence and need not be taken into consideration.

CONGENITAL REDUCIBLE INGUINAL HERNIA.—This forms a very important group and in practice we find two chief conditions; in one the testicle is in its normal position and there is a patent canal from the abdomen to the bottom of the tunica vaginalis, and in the other the testicle is only partially descended. The so-called "infantile hernia" does not complicate the operation for radical cure; it simply means that the surgeon has to do an operation for hydrocele as well as the radical cure.

(a) **The treatment when the testicle is in the scrotum.**—We have already dealt with trusses for these cases and with the time at which a radical cure should be performed (see p. 440). The early steps of the radical cure are similar to those for ordinary oblique inguinal hernia (see p. 450) up to the division of the external spermatic fascia. The white band that the open funicular process forms among the structures of the cord should be

gradually defined and divested of the surrounding fascia. In order to make sure of its nature a small incision should be made into it and its interior explored for a communication with the abdomen by a probe or with the finger. In these cases the vas is much more intimately connected with the wall of the sac and is more difficult to separate than in the ordinary form and care must be taken not to injure it as it is very fragile in children. The best plan is to strip the structures off the sac with a fine dissector until the probe end of the dissector can be pushed between the vas and the wall of the sac; then it is easy to strip it off.

It is well to slit up the external ring so as to see the neck of the sac and its relation to the vas. The funicular process should be cleared down to the testicle, which is readily pulled up out of the scrotum during the manipulations so that there is no necessity for extending the incision down. The process should be divided just above the testicle. Many surgeons advise that the lower end of the process should be closed by a continuous suture so as to form a tunica vaginalis; in our experience this has sometimes been followed by a hydrocele and we always leave it open. The rest of the operation is similar to that already described for an ordinary radical cure (see p. 452).

(b) **The treatment when there is imperfect descent of the testicle.**—Here the operation is more difficult as, in addition to the rádical cure of the hernia, the testicle must be brought into its natural position in the scrotum. In the few instances in which this is found impossible the operation is much simplified by castration, but in our experience the testicle may be brought into the scrotum in the great majority of cases, as will be fully described in connection with undescended testicle. The radical cure of the hernia is in all essentials similar to that just described, but extra care must be taken not to injure the vas, which will be found on the outer wall of the sac and very tortuous towards the lower end; it is easily divided in cutting off the sac close to the testicle unless great care be taken to trace it to its origin.

DIRECT REDUCIBLE INGUINAL HERNIA.—This is a much more difficult and more unsatisfactory form of hernia in which to do a radical cure. The sac comes down internal to the deep epigastric artery, either pushing before it the conjoined tendon or passing through a space in it. The cases usually occur in oldish people and the neck of the sac is usually so broad that it cannot be well treated by twisting or ligature. The neck of the sac, *i.e.* the peritoneum forming the floor of the lower part of the inguinal canal, should be thoroughly cleared, and inspected to see that it is not adherent to the bladder at the inner side. The sac is then opened, the contents returned, the sac cut away and the peritoneal cavity closed by a fine continuous catgut suture.

It is necessary here to close the canal and this is best done in our opinion by Halsted's operation (see p. 448), which enables the posterior wall of the canal and also the external oblique to be closed over the whole

region; Bassini's operation (see p. 446) is probably the next best. The probability is that the wound may bulge subsequently and the patient may have to wear a truss, but this should not be commenced until bulging has actually taken place; we have had quite a number of cases in which no truss has been necessary.

INTERSTITIAL HERNIA.—Here the sac passes upwards behind or between the abdominal muscles. In some cases the sac turns up at the internal ring and lies entirely in the substance of or behind the abdominal wall, in others it has two projections, one extending downwards along the canal and forming a bubonocele, while at the neck there is a diverticulum running up in front of the peritoneum.

Radical cure is really called for here more frequently than in the ordinary herniæ, because the neck of the sac is bent and strangulation is very apt to occur. A truss is very inadvisable because it is by no means easy to be sure that the contents have been all returned.

The operation is practically the same as that already described (see p. 450). When there is no bulging in the inguinal canal the external oblique must be slit up to expose the internal ring and the sac is found projecting upwards behind the abdominal wall. It is pulled down and treated in the usual manner (see p. 442); there is generally no necessity for putting stitches in the canal except to close the slit in the external oblique. When part of the sac is in the inguinal canal, the operation is more easy because, as the main sac is cleared and pulled on, the diverticulum behind the muscles becomes exposed. In these cases Bassini's method (see p. 446) may be used with advantage.

IRREDUCIBLE INGUINAL HERNIA.—Here the operation is quite similar to that described above (see p. 450), but in all cases it will be necessary to slit up the external oblique, so as to have the entire sac exposed. The latter is opened and any adhesions are carefully divided or torn through; any oozing point should be clamped and tied. The separation proceeds until the omentum is absolutely freed and it is possible to pull down healthy omentum in all directions. There are generally only a few tags adherent and after separating these there is no difficulty in returning the omentum into the abdomen; the subsequent proceedings are similar to those already described.

In long-standing cases, however, the omentum is not only adherent but much altered and its return into the abdomen is difficult and inadvisable. Therefore, after clearing all the adhesions, the omentum is pulled down until the normal portion is seen and then the thickened part is ligatured in sections (see Fig. 91) and the stump returned, care being taken not to remove it nearer to the colon than one inch. The finger is pushed up into the abdomen to see that the stump is clear of the internal ring, as otherwise adhesions may form and inconvenience the patient afterwards. When the intestine or other structures are adherent to the sac the lines laid down on p. 465 must be followed. When the neck of the sac has been torn in

separating the adhesions its closure must be either by ligature if possible, or the sac must be cut clean away and a continuous suture made to unite the edges of the peritoneum. In these cases it is always necessary to repair the canal and this should be done by Bassini's method (see p. 446).

As regards the *obstructed*, *inflamed* or *strangulated* forms of oblique inguinal hernia, there is nothing to add to what has already been said (see Chap. XXII.). When taxis is performed for inguinal hernia the thigh should be flexed to a right angle and rotated inwards; full details will be found on p. 429.

In the text-books instructions are given to divide the neck of the sac or the internal ring directly upwards in cases of strangulated hernia. As a matter of fact, while the relation of the deep epigastric artery to the neck of the sac is a very important point to bear in mind, we always slit up the external ring in all cases of strangulated hernia and so we have the neck of the sac freely exposed before us, and this obviates all risk of injuring the vessel wherever it be. Moreover we have never found it necessary to nick the muscles; we have always found the stricture in the neck of the sac and division of the latter followed by stretching the ring with the fingers has always rendered reduction easy.

FEMORAL HERNIA.

This form of hernia descends through the femoral canal on the inner side of the femoral vein and pushes before it in its descent the sub-peritoneal fascia, the septum crurale, the sheath of the femoral vessels and the cribriform fascia. These structures are seldom sharply marked off from one another, and there is often much fat among them, so that the sac may lie in the midst of a projecting fatty mass and may be difficult to find, especially when empty. After emerging from the saphenous opening the hernia as it enlarges travels upwards to Poupart's ligament and outwards over the femoral vessels; this is important to remember in attempting reduction. Femoral hernia generally occurs in adults and is very rare before puberty. It is more common in women and is the commonest form of hernia in that sex. When it becomes strangulated the constriction is usually in the neck of the sac, but in a large and much distended hernia the neck is pressed firmly against the edge of Gimbernat's ligament and mere division of the former will not always allow the hernia to be reduced. Gimbernat's ligament does such severe injury to the neck of the hernia that gangrene is more common and occurs earlier than in any other form of hernia.

REDUCIBLE AND SIMPLE IRREDUCIBLE FEMORAL HERNIA.—The herniæ may be reducible or irreducible and of the latter there are the various forms already spoken of (see p. 426). The treatment of both the reducible and the simple irreducible forms is either by truss or by operation. In simple irreducible hernia a truss often causes so much pain that operative interference becomes imperative.

Trusses.—The truss most generally employed in femoral hernia is the form resembling the inguinal variety except that the pad is bent at a more marked angle to the spring and that there is no perineal band. The measurements which should be sent to the instrument maker are the same as for the inguinal variety except that the saphenous opening should form the starting-point and termination of the pelvic measurement instead of the external abdominal ring. Nothing need be added to the remarks made on p. 439 concerning the management and application of the truss. In reducing the hernia the thigh should be flexed and strongly rotated inwards, the neck of the sac drawn directly downwards and pressure exerted upon the hernia at first downwards and inwards and finally directly upwards.

Radical cure.—The radical cure of femoral hernia is not nearly so satisfactory as that of the inguinal form, but at the same time in patients under the age of forty it is best to perform it as they often suffer much pain from the truss, while the hernia is almost always irreducible and the radical cure, whether it enables the patient to do without a truss or not, at any rate allows the truss to be applied without any pain or risk of injury to the sac or the contents.

In femoral hernia, besides obliterating the neck of the sac, it is necessary to do something to reduce the size of the femoral canal, as otherwise recurrence takes place apparently invariably. Unlike the inguinal canal, the femoral is not bounded by active muscular fibres which close it every time the muscles contract, but is a rigid tube surrounded by fibrous tissue.

In order to deal with the canal various methods have been introduced which may be grouped into three classes according to their guiding principle. In the first the lower end of the canal is closed by occluding the saphenous opening, in the second the canal is mechanically plugged by a flap of pectineus muscle and fascia, and in the third the canal is occluded at its upper end, *i.e.* on its intra-abdominal aspect.

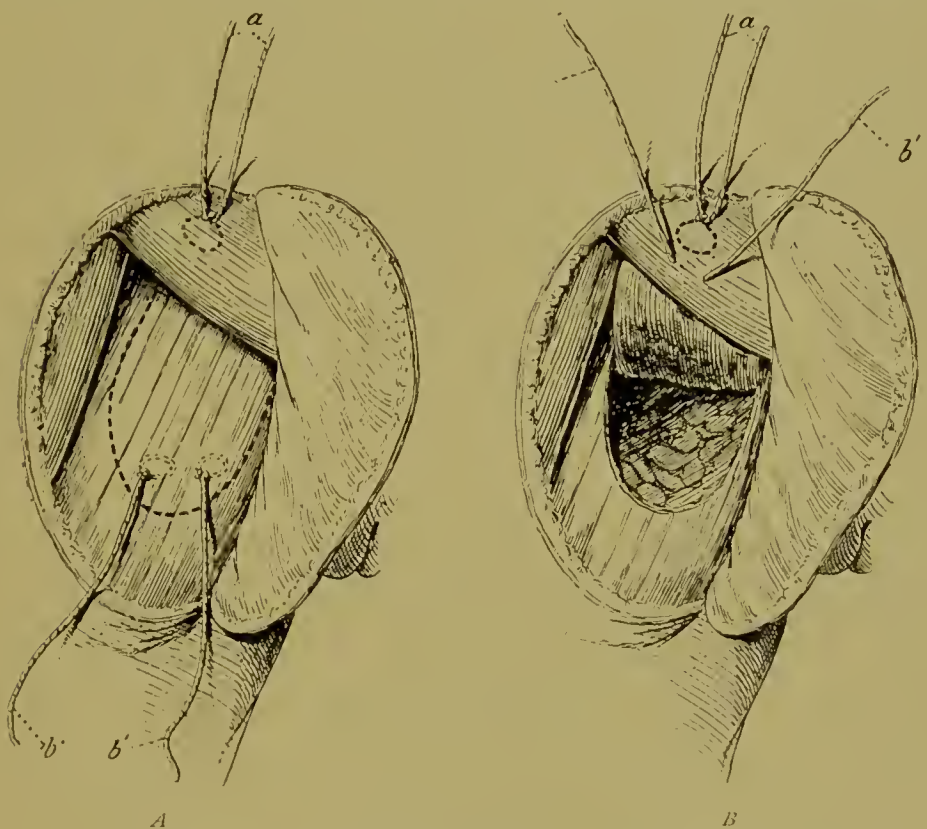
1. Bassini's operation, which is a good deal employed, aims at the closure of the lower end of the crural canal by silk stitches uniting Poupart's ligament with the pectineal fascia, the first being placed near the spine of the pubis and the others further outwards, gradually bringing down the cribriform fascia over the opening.

2. Some years ago we devised the following operation,[1] which has for its object an attempt to fill up the crural canal. A curved incision is commenced about an inch above the spine of the pubes, and curved outwards over the outer side of the femoral vessels and then inwards to the inner side of the thigh. This carries the incision away from sources of infection, and also enables the body of the sac to be cleared without trouble. When the flap is dissected inwards the cribriform fascia is exposed; the next step is to define the edge of the falciform ligament and detach the cribriform fascia. In a stout patient a mass of sub-peritoneal fat is next met with which must be very

[1] See *Lancet*, 2nd November, 1892.

carefully separated and in the upper part of which the hernial sac will be found. The sac must be cleared well up to its point of exit from the crural canal and should then be opened to ascertain whether there is any adherent omentum; if so, it must be detached in the usual manner.

The next procedure is to twist or ligature and remove the sac. The neck must be carefully examined to see whether the bladder be adherent to its inner aspect because in more than one instance a portion of it has been included in the ligature with a fatal result. The sac if twisted is pushed up well inside the



A B

FIG. 122.—RADICAL CURE OF FEMORAL HERNIA BY MEANS OF A FLAP OF THE PECTINEUS MUSCLE. In *A* the neck of the sac has been drawn upwards away from the crural ring by the ligatures around its neck (*a*). The dotted line shows the flap that is to be cut from the pectineus muscle and its fascia; the sutures that are to keep it in place in the crural canal are also seen in place. In *B* the pectineal flap is seen pulled up into the crural canal; it is secured in position by tying the ends of the sutures *b' b'*.

abdomen, if ligatured, the ends of the ligatures should be carried through the abdominal wall above and outside the femoral canal by means of a nævus needle so as to pull the remainder of the neck of the sac well away to one side (see Fig. 122, *A*). Great care must be taken to avoid any stretching or division of the crural canal, or of Gimbernat's ligament itself which will militate against a real radical cure.

The closure of the canal is now effected by first clearing the fascia covering the pectineus with the handle of the knife and then marking out a flap of pectineal fascia and its subjacent muscle of sufficient size to fill up the crural canal without any tension, after allowing for retraction of the divided muscle

fibres. The incision begins on the inner wall of the crural canal, runs for a short distance parallel to Poupart's ligament and then curves downwards, outwards and is finally carried upwards (see Fig. 122, *A*); the last part of the incision can be made by separating the muscular fibres with the handle of the knife and thus the femoral vein which lies alongside of it will escape injury. The greater part of the thickness of the muscle is included in this flap which is peeled up with the handle of the knife, and special care must be taken to see that its pedicle is sufficiently long to admit of its being pulled well up into the crural canal. At the lowest angle of the flap two stitches are passed and one end of each is left long, threaded on a nævus needle and carried up the crural canal and through the abdominal wall above and to its outer side; when these are pulled upon the flap is dragged into the crural canal right up to the upper end; if there be any difficulty in getting it up it may be packed in with the handle of the knife (see Fig. 122, *B*). The stitch is then tied and the operation is completed by inserting two or three stitches between the edge of the cribriform fascia and the muscular fibres and the periosteum behind. It is well to introduce a small drainage tube for two days at the lower angle of the wound as there is often considerable serous oozing.

3. An attempt has recently been made to close the upper part of the canal by turning in the lower part of the tendon of the external oblique at its junction with Poupart's ligament,[1] and interposing a sheet of fascia as a barrier across the upper opening of the crural canal. Mr. Battle speaks favourably of the method in the cases in which he has tried it but we have not yet had an opportunity of employing it.

STRANGULATED FEMORAL HERNIA.—The operation for strangulated femoral hernia is essentially the same as for the inguinal form (see p. 457), but here it is seldom possible to reduce the bowel without nicking Gimbernat's ligament, which should be done in a direction upwards and inwards.

When the hernia is gangrenous and requires excision, this is better done from a fresh abdominal incision than from the wound in the thigh. It is very difficult to bring down enough of the gut through the crural canal to manipulate properly and, if any artificial aid to anastomosis has to be employed, the loop cannot be got back again without very dangerous pressure. The original skin incision should be prolonged upwards, the inguinal canal opened and the intestine exposed as it enters the crural canal. The strangulated loop can then be drawn out of the abdomen through this opening but care must be taken to pack it all round so as not to soil the peritoneum in drawing the hernia out. It is usually easier to pull the hernia out from above than to push it back from below.

Femoral hernia rapidly becomes gangrenous when strangulated and it will often be necessary merely to open the bowel and form an artificial anus, which may be closed afterwards (see p. 469), but, if the patient's condition be good, it is best to try to restore the continuity of the intestine at once.

[1] See *Lancet*, 1901, vol. i., p. 302.

UMBILICAL HERNIA.

Umbilical hernia is a protrusion of some of the abdominal contents through the umbilicus or an opening in its immediate vicinity. In infantile hernia the protrusion is directly through the umbilicus. In adults the opening is supposed to occur through the space through which the umbilical vein originally passed, although some surgeons hold that the opening is really in the abdominal wall above the exit of the cord. The coverings of an umbilical hernia are peritoneum, fascia and skin. The sac always contains omentum, usually with the colon and sometimes also with small intestine.

In the herniæ of adults there are almost invariably adhesions between the contents and the sac, the omentum being often so adherent that it is practically impossible to separate it from the sac. Intestine may also be adherent to the sac wall or to the omentum, and the separation of the various constituents of an irreducible umbilical hernia is often a matter of extreme difficulty, and is sometimes impossible. These herniæ are very liable to become the seat of obstruction or strangulation; the strangulation occurs either at the point of exit through the umbilicus or beneath bands or through holes in the omentum. The latter point should be carefully borne in mind, and in strangulated cases the surgeon should not be content with reducing the contents of the sac as a whole: they must be opened out to see whether there is strangulation within the omentum. The omentum is much thickened, either by deposit of fat or by inflammatory exudation, and it is practically impossible to return the greater part of it into the abdominal cavity.

TREATMENT.—It will be best to consider the treatment (*a*) in infants and young children, (*b*) in adults, and (*c*) in old age.

Umbilical hernia in young children.—Here the protrusion is usually through the true umbilical opening, and, unless the case be neglected, it seldom attains any great size; it is remarkable that, if the hernia be well looked after, there is a strong tendency to closure of the opening without operative interference.

Trusses.—The aim of the surgeon is to apply an efficient truss from the time that the hernia first appears, which is generally during the first few weeks of life. During the early period the best arrangement is a pad fixed over the umbilicus by strapping; this pad should be quite flat and without any knob projecting into the opening as is so commonly found in pads bought at the instrument-maker's. A pad of the latter kind may retain the hernia, but it will prevent the closure of the opening. In infants home-made pads are quite sufficient. A flat piece of block tin about the size of half-a crown is covered first with strapping and then with linen, the child is laid on the back, the sides of the abdomen are supported so as to push forward the opening, and a piece of boracic lint is placed over the umbilicus. The pad is now applied and kept in position by rubber strapping, which should extend from the lumbar

region on one side to that on the other, and should be applied quite firmly and should be reinforced by oblique and vertical pieces. The whole arrangement is fixed on with a binder which gives general support to the abdominal wall. The greatest care must be taken in the management of these pads. The skin must be kept dry, fresh pads and fresh boracic lint should be applied whenever there is the least sign of soiling, and in any case once a day. If this treatment be persevered with, the opening will gradually close in the majority of cases and the hernia will be cured.

In older children it is sometimes more convenient to have a flat pad made of vulcanite sewn in an elastic abdominal belt. The same care must be taken of the skin beneath the pad, and, if the apparatus slips, the pad should be fixed with strapping and an elastic binder put on outside.

Radical cure.—If it be found after prolonged use of retentive apparatus that the opening does not close, operative measures may be

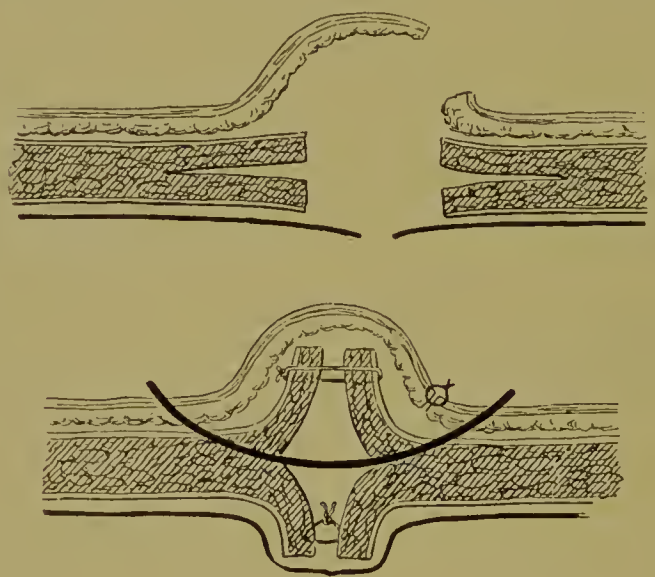


FIG. 123.—RADICAL CURE OF UMBILICAL HERNIA IN A YOUNG SUBJECT. The upper sketch shows the method of splitting the abdominal wall horizontally, while the lower one shows the two layers thus formed, sutured separately, while a stout mattress suture runs through the angles of the flaps on each side. The peritoneum and skin are sutured separately. It is the fibrous wall that is split; the recti are untouched.

required, and are usually quite satisfactory in these young children; there is no excess of fat, the opening is quite small and its sides are easily brought together. The skin over the hernia is usually thick, and may be turned aside as a flap so as to carry the line of suture in the skin away from that in the deeper parts. When the sac of the hernia is exposed it should be opened to see that none of the contents are adherent and then cut away, and the peritoneal edges sewn up by a continuous catgut suture which purses up the peritoneum. The opening in the abdominal wall is then closed. As a rule we try to do this in two layers, by lifting

up the edge of the opening and splitting the fibrous wall horizontally; we then suture each layer separately and apply mattress sutures through both layers so as to give extra support (see Fig. 123). After the dressing is applied the abdomen is supported by a firm binder. It is well to keep the patient in bed from four to six weeks so as to allow the union to become quite firm; during that period a stout binder is kept on, and for some months afterwards a suitable abdominal belt without any pad over the hernial orifice is worn.

Umbilical hernia in adults.—This is most common in women during the child-bearing period, and may be reducible or irreducible. In the latter case there is often much discomfort from adhesions of the omentum which anchor the transverse colon and in some cases pull upon the stomach; for this reason alone it may be necessary to perform a radical operation. Since operation is not nearly so satisfactory as in inguinal hernia, and since in young women the abdomen may again become distended and the union stretched, radical cure is not to be urged unless the hernia be irreducible and there be discomfort from adhesions. As long as the hernia is small and reducible a truss should be employed. This consists of a flat pad embedded in a firm elastic abdominal belt of large size and fitted with perineal straps. There is little chance that actual cure will result but, as long as the hernia does not increase in size or complications do not arise, this is of little moment. Should the hernia enlarge however and cause much discomfort, or should it become obstructed, it is better to attempt a radical cure unless there be some strong contra-indication.

The best subjects for radical cure are spare people with strong abdominal walls; fat persons with lax abdominal walls are bad subjects. The radical cure in an adult with a fair-sized hernia and with considerable separation of the recti, which is almost always present, is done as follows:

A large elliptical portion of the thin redundant skin is first excised so as to include the umbilicus. The incision should be so arranged that the long axis of the ellipse lies parallel to but on one side of the middle line, so that it and the cicatrix in the deeper parts shall not correspond. The sac is cleared from the skin, and this is easy in the irreducible cases, because the hernia is protruding. The neck of the sac is defined all round and the sac opened at any point where there are no adhesions. The adhesions in the interior are separated by the finger and, when the bowel has been returned, it is well to ligature the omentum and return the stump into the abdomen. It is generally impossible to keep the sac entire and the question arises how to deal with it as it cannot be twisted or indeed satisfactorily ligatured. Attempts to separate the peritoneum from the sides of the opening and to unite it by a continuous suture are unsatisfactory as there is a good deal of tension and the peritoneum is apt to tear. In our opinion it is better not to attempt this; we pass two or three mattress sutures according to the size of the opening by means of a Macewen's needle through the whole thickness of the abdominal wall from side to side and these bring the sides

of the opening together without difficulty as they take a firm hold on the fibrous walls. These sutures bring the peritoneal surfaces on opposite sides of the ring into apposition and then a continuous suture should be made to unite the superficial edges of the ring. Although this seems good approximation at the time, the cicatrix is apt to yield later on especially in women with lax abdominal walls and much separation of the recti. Gersuny recently advocated bringing the recti muscles back into their normal position in the middle line in order to avoid this. The sheath of the rectus is opened on each side and the recti are separated and brought inwards to the middle line where their adjacent edges are sewn together. In order to do this satisfactorily it is necessary to separate also the transverse fibrous bands in the rectus immediately above and below the umbilicus and therefore the incision must be free and in bad cases may have to extend from the xiphoid cartilage to the pubes. This operation is often a severe one and may be impossible in feeble and very fat persons. In comparatively spare subjects, on the other hand, it is not particularly severe and we have done it on several occasions with the most satisfactory results; in fact we consider it essential to a true radical cure.

After the operation the patient should be kept in bed for six weeks, and should wear a firm abdominal belt without any pad unless there be any protrusion.

Umbilical hernia in old age.—Here the hernia is practically always irreducible and large and the feeble musculature, the excess of fat, the size of the opening and the generally weak state of the patient preclude any attempt at such a radical cure as Gersuny's. The contents are usually inextricably mixed up and must be separated, which takes a long time, and there is no doubt that in Gersuny's operation, a fair amount of blood is lost and a good deal of shock is present. Hence the great majority of cases will be better off with a truss moulded to the shape of the hernia.

When these herniæ become strangulated, the patient's condition is desperate; the strangulation is difficult to relieve and the patient's general state is very bad. The source of the strangulation is often difficult to discover; frequently it is due to mere kinking, as when an overfull loop of intestine is abruptly bent over the lower edge of the umbilical opening. The only way is to open the sac freely and separate the structures until the cause of strangulation is found and relieved; the hole is dealt with in the manner above described. The great danger of strangulated herniæ and the difficulty of keeping up the hernia in old people are strong arguments in favour of an attempt at radical cure in young subjects, even though it should only succeed in enabling the patient to retain the hernia by a belt.

VENTRAL HERNIA.

Under this term we include herniæ which pass out at other points in the anterior abdominal wall than those already enumerated. Ventral hernia

may occur with or without previous injury and one of the most common causes is a laparotomy especially after a lateral incision, *e.g.* draining an appendicitic abscess. In other cases hernia may follow rupture of portions of muscles. The shape of the neck of the sac differs in various cases; sometimes the hernia comes through a small opening such as that left by a drainage tube, at others there is a much larger weak area, as after a free abdominal incision, and there is no regular neck to the sac.

TREATMENT.—Unless a well-fitting and comfortable abdominal belt keeps back the protrusion easily, an attempt should be made to repair the hernia. The hernial sac is freed, its contents returned into the abdomen, the sac excised and the peritoneum stitched up. The cicatricial edges of the opening in the abdominal wall are then cut away and the muscles are closely approximated by mattress sutures of silk; the approximation is completed by a continuous suture between the opposed surfaces.

The operation may be difficult because the viscera may adhere to the cicatrix and it will then be best to excise the edges of the hernial opening and to open the peritoneum at a little distance from the sac where there are no adhesions; if there be difficulty in separating adhesions, a good plan is to divide the peritoneum all round the adherent point and to return the intestine covered with the peritoneum into the abdomen and then to approximate the abdominal walls (*vide supra*).

LUMBAR HERNIA.

This occurs in the triangle of Petit, which is formed by the iliac crest below, the latissimus dorsi on the inner and the external oblique on the outer side. The abdominal wall is weak at this spot and violent strains may cause a hernial protrusion.

TREATMENT.—The best treatment is a truss with a large pad and a perineal strap to prevent it from slipping up. If the truss will not control the hernia or if it cause pain, as it often does from pressure on the crest of the ilium, it may be advisable to practise an operation much on the same lines as for ventral hernia (*vide supra*).

EXCESSIVE SEPARATION OF THE RECTI.

It is not uncommon in women as the result of repeated abdominal distension for the recti to become widely separated and to give rise to a marked bulging of the whole centre of the abdominal wall. If it should be desired to perform a radical operation, closure may be effected by inserting mattress sutures through the entire thickness of the abdominal wall as shown in the diagram (see Fig. 124) and approximating the recti by Gersuny's method (see p. 464).

OBTURATOR HERNIA.

This is a rare form of hernia, the sac being found in the obturator canal. The hernia descends downwards and forwards along the outer part of the horizontal ramus of the pubis. The sac usually lies in front of the fascia over the obturator opening and may pass either beneath the obturator externus or over it and beneath the pectineus and the adductor longus; the nerve and artery are usually to the outer side of the neck. The hernia, unless large, is rarely noticed in the thigh, and in the strangulated form the nature of the

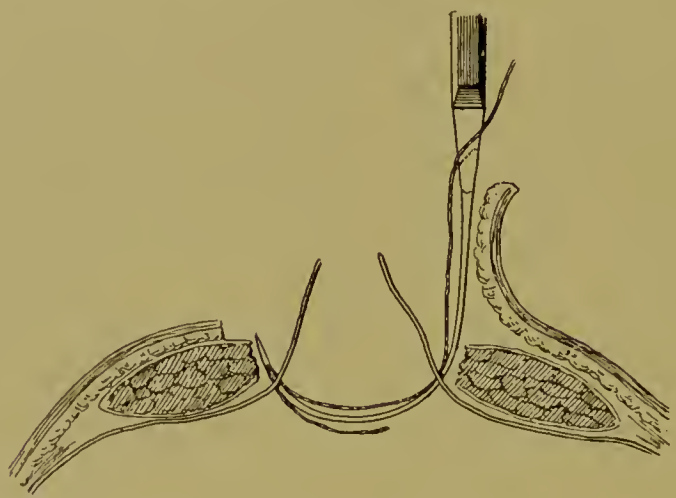


FIG. 124.—METHOD OF OPERATING FOR UNDUE SEPARATION OF THE RECTI. The inner edge of the rectus on each side is denuded of its sheath and the redundant peritoneum is cut away after a series of sutures have been inserted in the manner shown above.

case may be only discovered after the abdomen has been opened for acute intestinal obstruction. The hernia is very tightly nipped and, in most cases where an operation has been performed, the intestine has been found gangrenous.

TREATMENT.—If an obturator hernia be diagnosed, the only treatment is by operation because a truss cannot be satisfactorily applied.

The best way of dealing with these cases is to do a median sub-umbilical laparotomy with the patient in the Trendelenburg position and to add to this a vertical incision four or five inches long over the inner border of the pectineus, separating that muscle from the adductor longus in order to expose the obturator foramen. An attempt is made to remove the sac partly from the thigh wound and partly from the abdomen. If this be impossible, its neck should be divided between ligatures and the remains left in the foramen.

In strangulated cases recovery has followed pulling out of the gangrenous intestine with resection and end-to-end union after a median laparotomy. If it be necessary to enlarge the obturator foramen this is most safely done by an incision inwards.

CHAPTER XXIV.

FÆCAL FISTULA AND ARTIFICIAL ANUS.

From the point of view of treatment it would seem best to apply the term "fæcal fistula" to those communications between the interior of the intestinal canal and the surface in which there is no obstruction to the passage of fæces along the bowel and in which therefore only a small portion of the contents escape, while the larger proportion, and at times all, passes on along the ordinary route. The term "artificial anus," on the other hand, may be limited to the cases in which there is a distinct obstacle to the onward passage of the fæcal contents and in which they all or almost all escape through the external opening.

FÆCAL FISTULA.

This condition as defined above may arise either from disease of the intestine or from operative procedures, and the intestinal opening may be immediately adherent to the abdominal wall or may lead into a cavity in the interior of the abdomen which communicates with the surface by a sinus. The latter condition is that not uncommonly met with after abdominal suppuration, especially in connection with the appendix. A fæcal fistula may also originate in connection with malignant disease of the intestine; perforation takes place and an abscess forms and discharges externally. The term artificial anus, however, is more appropriate to the cases in which the opening occurs above a malignant intestinal stricture. Fæcal fistula may follow rents of the peritoneal coat in tuberculous peritonitis (see p. 413), it may result from accidental wounds of the bowel in operations such as the removal of adherent ovarian cysts, or the surgeon may deliberately establish a fæcal fistula, as when an artificial opening is made into the cæcum. "Congenital fæcal fistula" has already been referred to (see p. 351); these are really cases of artificial anus because all the intestinal contents are discharged through the fistula owing to the diminution in the calibre of the intestine below the opening.

TREATMENT.—A fairly considerable number of fæcal fistulæ if properly treated tend to close of themselves, at any rate when the opening is not immediately adherent to the skin. Hence in fæcal fistula resulting from an abscess a considerable time may be allowed to elapse in the hope that the fistula will close spontaneously, and during that time the greatest care should be taken to see that there is no obstacle to the escape of discharges from the sinus. It is of the highest importance to provide free drainage from the sinus and if necessary the skin wound must be opened up and the cavity packed or drained so as to make it granulate from the bottom. The bowels should be kept well open and a non-irritating and digestible diet, such as one consisting of milk and farinaceous food, fish and pounded meat, should be ordered. The patient should be kept in bed, if possible in such a position as to make the opening of the fistula the highest portion of the intestine. Under this treatment closure is very liable to take place either by cicatrisation of the opening or perhaps more commonly by its adhesion to a neighbouring coil of the intestine, the omentum or the abdominal wall. The same may be said of fæcal fistulæ following operations.

When these fistulæ do not heal the treatment is very difficult. No plastic operation upon the external orifice will do any good because it only dams up the fæcal material in the remains of the abscess cavity and the best procedure seems to be to open the abdomen above the fistulous opening and to try to divert the fæcal stream by performing a lateral anastomosis of the bowel above with that below.

When the opening is immediately adherent to the skin, as when a fæcal fistula has been artificially produced, the opening often contracts and may indeed entirely close if the patient be kept at rest, the bowels kept freely open and the parts kept clean. The obstacle to closure in most cases is the spread of epithelium from the intestine to the skin, so that a mucus-lined tube is formed; complete closure cannot be hoped for if this forms, although considerable contraction may take place as time goes on. Should this be the case, a plastic operation must be done when the contraction has reached its limit. In some cases a mere paring of the edges followed by suture will suffice; when the defect is larger, a true plastic operation may be done by turning a thick flap of skin and fascia over the opening after paring its edges. These plastic operations may require to be repeated and even then they may fail. The best plan then will be to excise the affected portion of the bowel and to do an end-to-end anastomosis as for artificial anus (*vide infra*).

ARTIFICIAL ANUS.

Here there is an obstruction to the onward passage of the intestinal contents, so that the whole of them discharge through the opening. This condition is usually brought about intentionally by operation, the object

being to form a spur, due to projection forward of the posterior wall of the intestine which acts as a valve, covers the distal portion of the bowel and prevents the escape of fæces into it. This is done in colotomy, where one of the main points is the formation of an efficient spur. It also occurs in strangulated hernia where the affected loop has sloughed and a spur forms preventing the onward passage of the contents.

TREATMENT.—Here the chief obstacle to the onward passage of the contents is a spur formed by the posterior wall of the intestine. Of course this is the sole object of many of the cases of colotomy for malignant disease of the large bowel that it is not proposed to deal with further and the question of closing the artificial anus does not arise. When however an artificial anus is established for intestinal obstruction and the abdomen is opened subsequently and the tumour causing the obstruction is removed, or again in cases after resection of gangrenous intestine, closure of the orifice becomes important. The great point is to get rid of the spur, and a great variety of methods have been employed to do so; when it is removed the case becomes one of fæcal fistula which may close of itself or can be closed by a plastic operation (*vide supra*).

In many cases the most satisfactory method is to open the abdomen, excise several inches of the bowel including the artificial anus and unite the remaining portions by an end-to-end anastomosis as already described (see p. 306). Special care is necessary to avoid introducing septic material into the abdomen. The disinfection of the skin, which is impregnated with fæcal material, should be begun and repeated for some time—a couple of days—before the operation. The artificial anus should then be encircled by an elliptical incision and the skin should be dissected up around the opening, turned up and stitched closely together so as to prevent the escape of the intestinal contents during the operation. This incision is now carried through the abdominal wall close to the attachment of the bowel and the peritoneum is opened at a spot where the latter is not adherent to the bowel beneath. The finger introduced into the peritoneal cavity will define the line of adhesion of the peritoneum to the bowel and the former should be divided with blunt-pointed scissors just outside this point all round. The bowel is thus freed from the abdominal wall and has the skin around the artificial anus still adherent to it and stitched over the orifice. The loop being now thoroughly freed, it is drawn as far as possible out of the wound, the general peritoneal cavity is shut off by cloths and a resection is performed as for an ordinary case of injury or obstruction (see p. 306).

There are various other methods of getting rid of the spur, the earliest of which was the use of Dupuytren's clamp, one blade of which was introduced into each portion of the intestine and then the two gradually approximated. This caused peritonitis between the adjacent limbs of the bowel and the part included in the clamp actually sloughed. The pressure was so arranged that the clamp did not slough through until about the seventh day when it only remained to repair the external opening.

Operative means having a similar object have now largely taken the place of clamps of this kind, of which quite a number have been invented. The artificial opening is plugged, the skin is thoroughly purified, an incision is made into the abdomen a little above the opening and the angle between the two portions of the bowel running to the artificial anus is exposed. A line of sutures front and back is now applied so as to unite the opposed serous surfaces of the bowel and then the blades of a pair of scissors are introduced through the external opening, one into each limb of the loop, and the approximated walls of the bowel cut through within the sutured area. Gauze is introduced into the bowel so as to prevent immediate adhesion of the surfaces divided by the scissors, and in a few days the external orifice may be pared and closed.

Others have suggested opening the abdomen higher up and doing a lateral anastomosis; if a large opening be made and a pad and truss applied over the external opening the fæces will find their way through the anastomosis and, when contraction of the intestine below it has reached its limit, a plastic operation may be performed to close the external opening. In our opinion however the best way of closing an artificial anus is by resection of the portion of the intestine containing the spur when it can be done; the resection should of course be followed by end-to-end suture.

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GLASGOW: PRINTED AT THE UNIVERSITY PRESS BY ROBERT MACLEHOSE AND CO.

A LIST OF WORKS ON

MEDICINE, SURGERY, AND GENERAL SCIENCE.

PUBLISHED BY

LONGMANS, GREEN, & CO.,

39 PATERNOSTER ROW, LONDON, E.C.

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